

**THE COST OF INACTION ON  
CLIMATE CHANGE**

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**HEARING**  
BEFORE THE  
**COMMITTEE ON THE BUDGET**  
**UNITED STATES SENATE**  
ONE HUNDRED SEVENTEENTH CONGRESS  
FIRST SESSION

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## THE COST OF INACTION ON CLIMATE CHANGE

THURSDAY, APRIL 15, 2021

U.S. SENATE,  
COMMITTEE ON THE BUDGET,  
*Washington, D.C.*

The Committee met, pursuant to notice, at 11:01 a.m., via Webex and in Room SH-216, Hart Senate Office Building, Honorable Bernard Sanders, Chairman of the Committee, presiding.

Present: Senators Sanders, Stabenow, Whitehouse, Warner, Merkley, Van Hollen, Padilla, Graham, Grassley, Crapo, Braun, and Scott.

Staff Present: Warren Gunnels, Majority Staff Director; Nick Myers, Republican Staff Director; Ethan Hinch, Majority Legislative Aide; and Becky Cole, Republican Policy Director.

### OPENING STATEMENT OF CHAIRMAN BERNARD SANDERS

Chairman SANDERS. Let me call the hearing to order. Let me thank Ranking Member Graham, our colleagues on this Committee, and our witnesses for being with us this morning.

In my view, we are living through a pivotal moment not only in the history of our country, not only in the history of the global community, but in the history of humanity. When we talk about our responsibilities as human beings, as parents, and as grandparents, there is nothing more important than leaving this country and the entire planet healthy and habitable for our kids, grandkids, and future generations. This is a moral responsibility that we cannot shirk.

So today let us be clear. The debate is over. The scientific community has spoken in a virtually unanimous voice. Climate change is real. It is caused by human activity and is already causing devastating damage to our country and throughout the world.

The scientists have told us that we as a global community have less than a decade, fewer than 10 years, to act boldly to transform our energy system away from fossil fuels and into energy efficiency and sustainable energies or our entire planet will face irreparable harm.

If we do not get our act together, we will see more devastating and extreme heat. We will see more floods, more rising sea levels, more extreme weather disturbances, more ocean acidification, more drought, more famine, more disease, and more human suffering.

Now, I have heard from some of my colleagues and some very powerful special interests that the cost of combating climate change

is expensive. And that is true. They are right. But my response is: Compared to what?

So let us be clear. The cost of inaction, of not combating climate change, will be far, far more expensive in every way than transforming our energy system away from fossil fuel. The economists have estimated that the cost of not acting on climate change will total some \$34 trillion in the United States alone in lost economic activity and more than \$100 trillion throughout the world by the end of the century. And if you are not worried about the financial costs, the scientists have told us that the cost of climate inaction may put the entire planet and life as we know it in serious jeopardy.

In fact, if we do nothing, the effects of climate change will lead to the deaths of 1.5 million people across the globe every single year from factors such as malnutrition, heat stress, and tropical diseases such as malaria. If we do nothing, the effects of air pollution in the United States will lead to the deaths of almost 300,000 Americans between now and the year 2030. If we do nothing, the effects of climate change will throw over 100 million people throughout the world into extreme poverty. If we do nothing, the World Bank has told us that the effects of climate change could result in the mass migration and displacement of more than 140 million people in Latin America, South Asia, Sub-Saharan Africa, and other locations by the year 2050. And when millions of people migrate, no one doubts that international tensions rise, and the likelihood of armed conflict increases.

While some of my colleagues may still refer to climate change as a hoax, let us be clear. This so-called hoax threatens to destroy our food and water supply, flood our cities and towns, and displace millions of people from their homes.

Let us talk for a moment about rising sea levels. What the scientists have told us is that unless we reverse course, major portions of New York City, London, and Hong Kong are at risk of chronic flooding by the end of the century while cities like Miami, New Orleans, and Atlantic City could be inundated by severe flooding much sooner.

Let us talk about extreme heat. Last year was tied for the warmest year on record, and all of the 10 warmest years in recorded history have occurred since 2005. The Centers for Disease Control, the CDC, has found that extreme heat events “are the most prominent cause of weather-related human mortality in the U.S., responsible for more deaths annually than hurricanes, lightning, tornadoes, floods, and earthquakes combined.”

Let us talk about extreme weather disturbances. Last year, we had the most active Atlantic hurricane season on record. Further, over the past 5 years, major natural disasters caused more than \$615 billion in damage and nearly 4,000 deaths.

Let us talk about wildfires. Last year was one of the worst U.S. wildfire seasons in recorded history, and the three worst U.S. wildfire seasons in terms of acres burned have occurred over the last 6 years. Scientists tell us that these fires are getting bigger and more severe because of climate change.

In my view, we have a fundamental choice to make. We can listen to the fossil fuel industry and climate deniers and not worry

about the impact of climate change. Or we can listen to the scientists who tell us that we have got to act boldly and aggressively to prevent a climate catastrophe.

In my view, we have spent far too long and wasted too much time discussing whether or not climate change is real. This debate was not driven by science but by a decades-long campaign of lies, distortion, and deceit funded by the fossil fuel industry. Oil companies knew by the late 1970s that the emissions from their products were causing irreparable harm to the planet. Back in the 1970s they knew that. And yet instead of working to solve or even acknowledge the problem, they followed the campaign plan designed by Big Tobacco to make sure our Government remained inactive in terms of combating this global crisis.

In the end, sadly, history is likely to judge the actions of the CEOs of fossil fuel companies as causing more death and more human misery than the tobacco industry, and that is quite a legacy.

And let us also understand something extremely important, not widely known, and that is, despite all of the discussions about climate change that we have, unbelievably we are continuing today down the same path. Over the next 10 years, fossil fuel activity in the United States is on track to account for 60 percent of the global growth in oil and gas production. In 2019, the United States was the world's second largest emitter of greenhouse gases. Our emissions per capita were 77 percent higher than China, which was the largest emitter, and 85 percent higher than the European Union (EU). That is not sustainable.

In my view, we have got to make it clear to the fossil fuel industry that their short-term profits are not more important than the future of our planet. At this hearing we will explore the cost climate change has had and will have on our planet.

Among many other actions that must be taken, we cannot continue to hand out corporate welfare to the fossil fuel industry, and that is why today I, along with Senators Merkley, Markey, Booker, Van Hollen, and Warren, introduce the End Polluter Welfare Act, which would abolish \$150 billion in tax loopholes, subsidies, and special interest giveaways to the oil, gas, and coal industry over the next decade. The devastating impacts of climate change are here, and now is the time for Congress to take action.

As it happens, I invited the CEOs of Exxon, BP, and Chevron to testify today and tell their side of the story. All three declined. But I am pleased that we have an excellent panel of witnesses who will discuss the cost of climate change and what taxpayers can do about it.

Now let me turn the microphone over to Ranking Member Graham for his opening remarks.

#### **OPENING STATEMENT OF SENATOR LINDSEY GRAHAM**

Senator GRAHAM. Thank you, Mr. Chairman. I appreciate it very much. I look forward to the testimony today.

I will just speak for myself here. I have come to conclude that climate change is real, that human emissions create a greenhouse gas effect that traps heat, and that you see a rise in the oceans and

acidity in the water and droughts and disruption of weather patterns. That makes sense to me.

I have been to Norway with Senator McCain, Greenland, I think, with Senator McCain and Senator Clinton at the time, and Alaska. The native people in those regions have seen a dramatic change. So count me in on the idea that the science is real.

The solutions I think are becoming more obvious to me. There are three areas of carbon emissions, basically, in our lives: transportation, power production, and living—homes and offices. So we have some folks from Johnson Controls. They are going to tell us about how we can lower emissions through energy efficiency, that we can have toasters and thermostats and every kind of device we use daily can be more energy efficient, lowering the cost to consumers and lowering demand on production. Count me in for that. Weatherizing buildings, having the buildings of the future, maybe have solar panels on top of our houses—there are just endless opportunities in the office space, consumer utilization, and home living that would be a win for the climate, for the environment, as well as the consumer in terms of lowering cost. It will take an investment, but I think it would be an investment worth making.

On power production, wind and solar's footprint is getting bigger. There are all kinds of new technologies coming on board that are clean in nature. I think natural gas is a bridge fuel. I think natural gas has a lower component. To our friends in the coal world, I met a gentleman a couple days ago who believes that coal can be transformed, not burned, to create a product that will go into electric vehicles, batteries.

So I am trying to make this—I am trying to be creative. On the transportation side—nuclear power is a big deal for me. It is clean in its emission, but we have a storage problem of spent fuel, and I think there are ways we can deal with that.

On the transportation side, probably the most exciting of all, Mr. Chairman, is that many major car manufacturers have said that they are going to go to an electric vehicle fleet by 2035, 2040. So I would like to sit down with the Chairman and other Democrats to see if we could redesign the Highway Trust Fund. Electric vehicles are not paying into the trust fund.

I was told yesterday that the Biden administration opposes an increase in the gas tax. Well, you know, I am a Republican, but we have increased gas taxes at home in South Carolina because the Highway Trust Fund has a huge deficit. And I know it is a regressive tax, but there are ways maybe we can do rebates. So count me in for accelerating the electrification of the transportation system. You may have hydrogen-fueled vehicles that do not emit CO<sub>2</sub>.

So there are a lot of things going on, and one of the roles that we can play at the Federal level is to encourage these developments through research and development (R&D). Bill Gates, I have talked to extensively. He thinks that the major thing that the Government can do is create some robust funding for R&D and let the private sector sort of flourish.

Now, when you say “we,” I hope you mean India and China, because “we,” the family of nations here, it does not do much good for us to do all this if other people do not follow. But to my Republican colleagues, it is just a matter of time until most cars—you

know, I do not know how long I am going to live, but in this century for sure that most vehicles will be running on something other than gasoline. I have talked to the fossil fuel industry. I find them very open to change. They just want to be able to manage that change. It will be a while before we get away from gas-driven cars, and we are going to need gas as a transportation fuel. It is possible natural gas as a heating source is very much with us. So count me in for exploring clean energy, but thinking outside the box what that would include, algae and nuclear power.

So I will just end with this: I have tried to learn about the problem and realize that what we do here has to be done in a fashion to not destroy our economy in the name of a great cause. Other people have to come on board, too. I try to be rational about threats. I think climate change is a real threat to our way of life. I think over time the way we have lived has caused this problem, and we can find a way to live a different way that is good for the environment and will be good for job creation.

From a foreign policy point of view, imagine the world where fossil fuels were not so readily available to rogue regimes. Imagine a world where the Iranian Ayatollah could not rely on oil production as almost 90 percent of his income. The Russians. I find it kind of interesting that the foreign policy consequences of moving to a clean energy business footprint would change the geopolitics of the world dramatically. Most of the bad actors out there depend on fossil fuels for their revenue. So that is a side of it that I think we need to talk more about.

And, finally, threats. My Democratic colleagues are telling me that the planet will cease to exist as we know it in a decade. Maybe so. I am not so sure I am sold on that, but I am definitely sold on the problem of climate change being real, and the sooner we address it, the better. And I just wish you had the same attitude about Afghanistan. We are down to 2,500 troops, and we are going to withdraw them all, and radical Islam is going to come roaring back unattended. And we know what they can do if nobody is watching them. So I find it disappointing that we cannot look at threats rationally across the board, Mr. Chairman. For a relatively small investment compared to the past, we could make sure that al Qaeda and ISIS never come back to receive sanctuary in Afghanistan. And here is what I want to remind you of: Climate change is real. The devastation of the planet is definitely happening. At what rate we can debate, but it is real. If they could get a nuclear weapon, ISIS and al Qaeda, would they use it? Yes. If they could find a way to do something other than fly planes into buildings to kill more of us, would they? Yeah. That threat is really real, and we are basically leaving it unattended.

So count me in for dealing with threats across the board, rationally, the lowest cost possible, the least disruption possible, the least wear and tear on our military. But ignoring a threat, Mr. Chairman, does not make it go away. Count me in, in working with you to deal with the threat the planet faces from climate change. I hope you and your colleagues on the other side will look at threats that radical Islam presents to the Nation and the world and see if our policies make sense.

Chairman SANDERS. Senator Graham, thank you very much.

We have an excellent group of panelists, and let me begin with David Wallace-Wells. Mr. Wallace-Wells is editor at large at New York Magazine and author of “The Uninhabitable Earth,” an international bestseller describing the risks we face from inaction on climate change.

David, thanks very much for being with us.

**STATEMENT OF DAVID WALLACE-WELLS, EDITOR AT LARGE,  
NEW YORK MAGAZINE, AUTHOR, “THE UNINHABITABLE  
EARTH: LIFE AFTER WARMING”**

Mr. WALLACE-WELLS. Thank you, Chairman Sanders. Thank you, Ranking Member Graham and other members of the Committee. It is a privilege to be here today.

In 2020, what was once called a “novel coronavirus” killed, according to the CDC, 350,000 Americans. According to new research, that same number—350,000—die even in an unexceptional year from the air pollution produced from the burning of fossil fuels. Decarbonize, and we could save those lives.

The figures are so large they can seem almost hard to credit, but this is a familiar paradox from climate science which offers harrowing assessments, we know, must know, also offer the clearest picture we have of the uncertain future that awaits us should we fail to act. Globally, 8.7 million annual deaths have been attributed to fossil fuel pollution. That is death at the scale of the Holocaust every single year.

The average resident of Delhi has had his or her life expectancy cut short by 9 years. Globally, the figure is 2 years.

Now, here in the U.S., we have what qualifies as enviable air quality. According to the Natural Resources Defense Council (NRDC), the Clean Air Act is still saving 370,000 American lives every year, delivering economic benefits of \$3 trillion annually, 32 times the cost of enacting that bill. But, unfortunately, many of these gains could be undone by pollution produced by wildfire. In 2020, American fires accounted for more than half of all air pollution in the western U.S., meaning that more particulate matter from the burning of forests infiltrated the lungs of Americans living in those States than from all other industrial and human activity combined.

Now, California is still standing, mostly, after its horrific fires, as is Australia after 46 million acres burned there last year, and Houston after five of what were once called “500-year storms” hit in a period of just 5 years. And we are still here today after a record \$22 billion weather disasters last year, debating what measures to take to stall the growth and blunt the force of warming—all a sign that climate impacts are not the whole of our destiny, but instead form the natural landscape on which our future will be built and contested.

Now, you may think of climate change as a slow process, but half of all of the emissions ever produced in the entire history of humanity have come in just the last 25 years. That is since Al Gore published his first book on warming; it is since the premier of “Friends.” That means climate responsibility for the present crisis and preventing its worsening is alive on the planet today. In fact, it is in this room.

Now, I am not an old man. I am 38 years old. Almost two-thirds of all carbon emissions ever produced have been produced in my lifetime. A quarter have been produced since Joe Biden was elected Vice President in 2008. A third have been produced since Senator Graham first joined the Senate.

To pull up short of what was once called a “catastrophic level of warming”—2 degrees—requires us to decarbonize at least as fast as that, and possibly faster. And if we do not? The future projected by science is shrouded by uncertainty about how the climate system will react and how humans will, too, both through mitigation and adaptation, which will be necessary.

But at just 2 degrees of warming, flooding events that would have happened once a century will come every year. The land burned by fires in the American West could grow twofold, perhaps sixfold. And because there is a natural limit on the amount of heat and humidity the human body can endure—a measured called “wet-bulb temperature”—cities across the Middle East and South Asia that are today home to millions would routinely be so hot during summer that you could not go safely outside and certainly could not work outside for long periods without risking heat stroke or death.

Past 2 degrees, and the number of deaths from air pollution could grow by 150 million. At 3 degrees, war could double. And estimates of the aggregate economic impact of unmitigated climate change are crude and vary widely, with some older models suggesting an impact of just a few percentage points, and others offering much higher estimates. Compared with a world without warming, between 2.5 and 3 degrees, the world would lose between 15 and 25 percent of per capita global output, according to one much cited paper, which means, of course, that much could be saved by avoiding it.

Now, just a few years ago, it seemed prudent to plan for scenarios north of 3 degrees. Thanks to a global political awakening, growing cultural pressure, and rapid improvements in the cost of renewables, those scenarios now appear considerably less likely. But even that new measured optimism is shrouded in uncertainty, too. And as any investor or economist would tell you, uncertainty itself is a cost—not an excuse for inaction, but the opposite. As they would also tell you, foregone benefits are a cost, too, and this I think is the biggest news on climate, that the benefits of decarbonization, once considered trivial, are, in fact, enormous. That is why last year Duke’s Drew Shindell testified before the House that a total decarbonization of the American electricity sector would entirely pay for itself through the public health benefits of cleaner air, why estimates of the jobs created by that work grow into the millions, and why during the pandemic and independent of any international pressure, ambitious net zero commitments were made by South Korea, Japan, the EU, and, most significantly, China, each stitching climate considerations and the benefits of action into every aspect of their planning and policy. They all see the gains to be seized. Do we?

Thank you.

[The prepared statement of Mr. Wallace-Wells appears on page 35]

Chairman SANDERS. Thank you very much.

Our second witness is Dr. Robert Litterman, the Chair of the Climate-Related Market Risk Subcommittee at the Commodity Futures Trading Commission. Dr. Litterman is a leading advocate for addressing climate risks in the financial markets, and he was named 2013 Risk Manager of the Year by the Global Association of Risk Professions.

Dr. Litterman, thanks so much for being with us.

**STATEMENT OF ROBERT B. LITTERMAN, PH.D., CHAIR, CLIMATE-RELATED MARKET RISK SUBCOMMITTEE, COMMODITY FUTURES TRADING COMMISSION**

Mr. LITTERMAN. Chairman Sanders, Ranking Member Graham, members of the Committee, thank you for inviting me to address the risks that climate change poses and my suggestions for how to deal with them.

The best science shows that damage from climate change is already serious and could range in the future from severe to catastrophic. Risks of this magnitude demand an immediate ambitious response, including a price on carbon. Today the world is hopeful for U.S. leadership on climate action, but appropriate management of climate risk requires action by this Congress.

My name is Bob Litterman. I am an economist by training and have spent my career managing financial risk. I chair the Commodity Futures Trading Commission's Climate-Related Market Risk Subcommittee, which published its report on managing climate risk in the U.S. financial system last fall. I worked at Goldman Sachs for 23 years where I finished as a partner in 2009. I led the firm-wide Risk Management Department and later managed the Quantitative Strategies Group in the Asset Management Division. I am currently a partner at an investment firm, Kepos Capital.

Financial risk management has several simple principles that apply to managing climate risk. Most importantly, risk managers must look at the full distribution of potential future outcomes. Risk management requires imagining and designing policies to prevent extremely bad but very plausible scenarios. Identifying these scenarios is especially hard for climate risk because we are performing this experiment for the first time on a very complex system. David Wallace-Wells has done a commendable job illustrating the scientific research on such worst-case scenarios.

Another principle of financial risk management which is perhaps not as obvious is that our objective is not to minimize risk but, rather, to price risk appropriately. For example, at Goldman Sachs we would charge traders for the risks that they took, forcing them to take risks only where the firm would be more than compensated by the expected returns on their trades.

A third principle of risk management is that time is a scarce resource. If we have enough time, we can solve almost any problem. It is when time runs out that risk breeds catastrophe. The risk from climate change is increasing as we fill the atmosphere with greenhouse gases. We do not know how much time we have before

we cross a tipping point, after which the threat of numerous environmental disasters becomes irreversible. This is an extremely urgent matter.

More colloquially, we are barreling toward a hazard of our own making. Now we need to brake fast and hard. We must reduce emissions and move rapidly to a net zero emissions economy. The scale and urgency of that transformation require that financial markets immediately and dramatically increase the flow of capital toward investments that will reduce emissions. Then we will almost certainly need to follow that by removing significant quantities of carbon dioxide from the atmosphere.

Making those investments profitable and fostering the innovation necessary requires putting a price on carbon. Whether it is the National Academies of Sciences, the Business Roundtable, or the American Petroleum Institute, to cite some recent examples, or a Nobel-winning economist like Professor Stiglitz, experts and interested parties largely agree.

The most straightforward manner to price carbon is placing a tax on fossil fuel production. The risk management component of the carbon tax is the incentive it creates to reduce emissions. The proceeds could be used however Congress determines. The Climate Leadership Council, which I co-chair with Kathryn Murdoch, has developed the Baker-Shultz Carbon Dividend Plan. There the revenues of a tax on fossil fuel producers would be returned directly to households, a just approach with progressive outcomes.

Other options include funding clean energy R&D or infrastructure investments given the significant budgetary effects of a carbon price.

I recognize that there are a variety of opinions about how to design a carbon price, but leadership and compromise can help build strong coalitions of support. To manage climate risks, the key would be to create a price immediately, set it high enough to reflect the risks imposed by greenhouse gas emissions, and apply it to emissions across the entire economy.

I and my colleagues stand ready to help you deliberate on these policies and do what is best for Americans and the future. Thank you.

[The prepared statement of Mr. Litterman appears on page 44]

Chairman SANDERS. Dr. Litterman, thanks very much.

Our next witness is Dr. Joseph Stiglitz, an economist and professor at Columbia University. Dr. Stiglitz received the 2001 Nobel Prize in Economics and served as Chairman of the Council of Economic Advisers in the Clinton administration. He was also lead author of the United Nations 1995 Intergovernmental Panel on Climate Change report.

Dr. Stiglitz, thanks for being with us.

**STATEMENT OF JOSEPH E. STIGLITZ, PH.D., PROFESSOR OF ECONOMICS, COLUMBIA UNIVERSITY**

Mr. STIGLITZ. Well, thank you for this opportunity to share with you some of my concerns about the large economic costs and huge risks of not taking strong actions now to deal with climate change and the large benefits of doing so.

Senator Sanders has already described a variety of numbers characterizing the adverse effects of climate change, and there are multiple studies providing similar numbers. Some of these downside risks are already apparent. In one recent year, for instance, the magnitude of the destruction associated with extreme weather events in the United States alone was more than 1.5 percent of gross domestic product (GDP), effectively wiping out more than 60 percent of the growth of that year.

Rising sea levels will put much coastal property under water, destroying homes and property values. Recent studies have documented the adverse effects of climate change on health.

During the past year, we have seen the inequities associated with COVID-19. Those associated with climate change are equally severe. But there is an additional dimension of inequity that speaks to our future: While COVID-19 disproportionately affected older Americans, climate change is a risk that we impose on our children and our grandchildren. If we leave them a world in which they will have to confront climate change and its consequences, we are truly bequeathing them a real debt, substantial lowering their standards of living.

We have been treating scarce resources, our environment, our water, our air, as if they were free. But there is no such thing as a free lunch. We will have to pay the check someday. Delay is costly. Taking carbon out of the atmosphere is far more expensive than not putting it into the atmosphere in the first place. A smooth transition is far less costly than the one we will surely face if we do not take action urgently.

There will be, for instance, a repricing of carbon assets. The price of carbon assets, such as those associated with coal, do not today adequately reflect the realities of climate change. The longer we delay dealing with climate change, the larger the necessary adjustments will be, and the greater the potential for huge economic disruption of the kind that we have just heard about, an economic disruption that could make the 2008 recession look like child's play by comparison.

Among the consequences would be devastation to our banks and our insurance companies. When large calamities occur, the Government will pick up the bill. This is a huge hidden liability on the Government's balance sheet. That is why it is imperative that we start assessing, regulating systemic climate risk.

I want to end on a sunnier note. Doing something about climate change could be a real boon for the economy. The number of jobs that will be lost in the old fossil fuel industries are dwarfed by those that will be created in the new industries. The value created in the new industries will also dwarf the value of the stranded assets in the fossil fuel and related sectors.

The current focus on changing to a green economy is already stimulating enormous innovation. The price of renewable energy has been plummeting. Our country especially has much to gain, because innovation is a key comparative advantage. If we are ahead of the game, we will develop technology that will be in demand around the world.

Government has an important role in enabling, facilitating, and encouraging the transition to a green economy. This is most obvi-

ous in public investments in infrastructure and R&D. But there is much more to be done. Ending fossil fuel subsidies is one example, and I commend the introduction of the bill to do that, requiring full disclosure of climate risks, changing statutes governing fiduciary responsibility to mandate looking at these long-run risks. We should not be insuring banks that make loans that put our climate at risk. There is, I believe, the need for the founding of a national infrastructure bank and for seeding the creation of community, State, and regional banks to facilitate green investments.

As we have already heard, prices help guide decisions. That is why assigning a near-zero price to resources that are scarce is such a bad mistake. We need to employ a significantly high social cost of carbon accompanied by regulations and public investments that will enable us to deal with the risks that have rightly been called “existential.”

This is a defining moment in history. On the one hand, we can ignore these risks, at great peril to our future. The costs of not taking action are huge. On the other hand, we can seize this opportunity. What we have accomplished in the last 20 years should provide us with the confidence that this new economy can provide a new era of innovation, creating more and better jobs and a higher standard of living. This new era will play to America’s strengths, to the determination and ingenuity of people and the vitality of its institutions, including those that have long fostered innovation.

Thank you.

[The prepared statement of Mr. Stiglitz appears on page 71]

Chairman SANDERS. Thank you very much, Dr. Stiglitz.

Our next witness is George Oliver, chairman and CEO of Johnson Controls and chair of the Business Roundtable Energy and Environment Committee. Mr. Oliver previously served as CEO of Tyco Safety Products and held several leadership positions during his 20-year career with General Electric. He also sits on the Board of Directors at Raytheon Company.

Mr. Oliver, thank you very much for being with us.

**STATEMENT OF GEORGE OLIVER, CHAIRMAN AND CHIEF EXECUTIVE OFFICER, JOHNSON CONTROLS, AND CHAIR, BUSINESS ROUNDTABLE ENERGY AND ENVIRONMENT COMMITTEE**

Mr. OLIVER. Thank you, Chairman Sanders, Ranking Member Graham, and members of the Committee. I am George Oliver, chairman and CEO of Johnson Controls. I also serve as chair of the Energy and Environment Committee at Business Roundtable and am appearing today on behalf of both.

I want to thank you for holding this important meeting and for the invitation to appear. Founded in 1885, Johnson Controls is a global leader in smart, healthy, and sustainable building technology solutions. Business Roundtable represents over 200 CEOs of America’s largest employers from across all sectors of the U.S. economy.

Climate change is real. It must be addressed. In 2007, Business Roundtable became the first broad-based business organization to recognize the threats of climate change and the need to address the

risks. In September, Business Roundtable released new policies and principles for addressing climate change. CEOs know that climate change poses significant environmental, economic, public health, and security threats.

At Johnson Controls, sustainability is our business. We committed to achieving net zero carbon emissions before 2040 and announced science-based targets for 2030. We are AAA MSCI rated and proud to be ranked among the 100 most sustainable companies globally. And that leadership is critical for our customers.

About 40 percent of global emissions are related to buildings. We tackle that with building products and digital capabilities like our OpenBlue platform to cut energy in buildings 50 percent or more.

One of the reasons companies have taken climate so seriously is because failure to address global climate change could mean trillions of dollars in lost U.S. GDP over the coming decades. It is clear the risks associated with unchecked climate change are real. They are increasing. They are costly, and they may be irreversible.

The U.S. must lead by example. Johnson Controls and Business Roundtable support a comprehensive policy to reduce greenhouse gas emissions and incentivize new technologies. Business Roundtable's September climate position outlines 11 principles to guide policy design. These include leveraging market-based solutions, preserving the competitiveness of businesses, and minimizing potential negative impacts while maximizing benefits.

I would like to discuss with you three key areas that will help us meet the scope of the climate challenge.

The first is energy efficiency. Johnson Controls partners with Government to deliver emissions reductions while decreasing the burden on the taxpayer. We are embarking on a partnership with General Services Administration (GSA) that will result in guaranteed savings of about \$6.2 million per year in energy and water across several historic buildings, including the White House Complex. It will also reduce greenhouse gases by 20,000 tons per year—the equivalent of removing 4,500 cars from the road. And Johnson Controls is leading similar efforts for our customers across all sectors.

For example, Mr. Chairman, in your home State of Vermont, we partnered with Rutland to modernize schools and reduce emissions. The project cut the need for capital by funding the upgrades through energy savings.

Senator Graham, in South Carolina we did a similar project for Charleston where we saved them over \$15 million and reduced carbon emissions by over 45,000 tons.

We encourage Congress to support performance contracting and public-private partnerships to save money and slash emissions.

The second is invest in technology. In cases like the building sector in which Johnson Controls operates, there is a clear pathway to significant, cost-effective emissions reductions. In other sectors, like steel, chemicals, and cement, it will require new technologies, breakthrough technologies. That is why Business Roundtable supports at least doubling Federal funding for advanced energy innovation and deployment of low emissions and carbon removal technologies.

Third is placing a price on carbon. Business Roundtable CEOs believe climate policy should begin with a market-based strategy and a price on carbon. Paired with public support for R&D and smart regulations, a clear price signal can encourage innovation, preserve competitiveness, spur growth, and provide assistance for impacted communities.

So, in conclusion, it is clear the risks and potential costs associated with unchecked climate change are real. The United States and the international community must aggressively reduce greenhouse gas emissions and incentivize new technologies. At Johnson Controls, we are taking on this challenge for ourselves and for our customers. We will cut emissions, cut costs, create good jobs, and more resilient, healthy infrastructure. I know many other Business Roundtable members are doing the same.

I want to thank you again for the opportunity to appear today. Together, I am confident we can tackle this problem. I would be happy to answer any questions that you might have.

[The prepared statement of Mr. Oliver appears on page 77]

Chairman SANDERS. Mr. Oliver, thank you very much for your presentation.

Our final witness is Richard Powell, executive director of ClearPath Incorporated. Richard has served on the advisory committee to the Export-Import Bank of the U.S. since 2019, and he is also on the Atlantic Council's Global Energy Center's Advisory Group. Previously, he worked for McKinsey & Company in their energy and sustainability practices.

Mr. Powell, thanks for being with us.

**STATEMENT OF RICHARD J. POWELL, EXECUTIVE DIRECTOR,  
CLEARPATH INC.**

Mr. POWELL. Good morning, Chairman Sanders, Ranking Member Graham, and members of the Committee. I am Rich Powell. I lead ClearPath. We advance policies that accelerate clean energy and industrial innovation. An important note: We receive no industry funding.

Given your role in America's fiscally responsible approach to climate change and the economic recovery challenges ahead, I will discuss five topics today: first, the threat climate change poses to our economy and Federal budget; second, the need to invest in targeted solutions versus endlessly spending; third, the opportunity for investments in clean energy like implementing the Energy Act of 2020; fourth, the reality that we can only build new clean energy projects as fast as we can permit them; and, fifth, the priority to build on the historic strong, bipartisan support for clean energy innovation.

Climate change is real, and global industrial activity is the dominant contributor, and the challenge it poses to society merits significant action at every level of Government and the private sector.

Lawmakers and businesses across the country are prioritizing investments in climate change adaptation efforts. For example, the Republican Florida State Legislature just last week advanced a bill to Governor DeSantis' desk which would require a master plan to

address sea level rise and flooding and established a fund providing up to \$100 million annually for climate resiliency projects.

Managing our country's debt will be another defining challenge of this century. As millions of Americans hand over their hard-earned income on tax day, they are also wondering how our national debt recently surpassed \$28 trillion.

Since 1980, the United States has spent \$1.9 trillion in disaster recovery from 290 billion-dollar events, all deficit spending. If we do not invest in adaptation and mitigation now, climate change will require massively deepening our deficit spending in the future.

As you consider the budgetary demands of these challenges and the President's "skinny budget" proposal, it is important U.S. policy synchronizes with the global nature of the climate challenge. Existing clean technology is simply not up to the task of global decarbonization.

The global supply of clean energy has remained stagnant since 2005. To make a dent in the global problem, we need to focus on breakthrough technologies. Developing countries choosing to buy and build clean energy technologies over carbon-intensive ones should be our goal. Today many developing countries are choosing Chinese coal plants because they are cheaper to buy, easier to build, and better performing as an energy system than the clean technologies available to them.

The U.S. cannot regulate or tax our way to a global solution. We do not have a magical mechanism to simultaneously regulate other countries' emissions. So what to do? We need to innovate and demonstrate here and deploy abroad. To do so, we must realize new energy technologies in the U.S. have not happened without investments from the Department of Energy (DOE). Two of the breakthrough clean energy technologies responsible for the more than 30 percent of carbon emissions reduction in the U.S. power system since 2005 are hydraulic fracturing and solar energy. Both followed the same pathway to success: early Government R&D targeted outcomes, partnerships with private industry, and tax incentives to facilitate commercialization.

This Government support, while useful, should expire as technologies become commercially viable. Without this Federal support, even a superior energy technology will not be able to break into the market because the incumbent technologies have the scale and supporting infrastructure of a 50-year head start.

The exciting news? At the end of 2020, Congress passed one of the biggest advancements in clean energy and climate policy we have seen in over a decade with the monumental Energy Act of 2020. Specifically, the Energy Act supports key research, development, and demonstration programs for more than 20 commercial scale projects across 5 major technology areas, like advanced nuclear reactors, carbon capture, or long-duration energy storage by the middle of this decade. DOE is most successful when it sets long-term, aggressive milestones to develop technologies at price points and performance levels that are meaningful for private markets. The priority now must be on implementing the Energy Act, fully funding these demonstration programs and overseeing rapid action at the Department of Energy.

As we reimagine our energy grid using exciting new technologies, permitting modernizations must keep pace. This transition will require tens of thousands of miles of new pipelines carrying hydrogen and captured carbon dioxide from power plants and industrial facilities, new transmission infrastructure to carry electricity around an increasingly electrified country, and new nuclear reactors and power plants sited everywhere. This will be the largest continental construction project in history, and every single project will begin with a permit.

Making the permitting process more efficient is essential for two reasons: stewardship of taxpayer resources and scaling clean energy rapidly. The bipartisan authorizations in the Energy Act and the most recent fiscal year 2020 and 2021 appropriations bills are great successes. I applaud the critical programmatic direction on clean energy innovation and look forward to seeing more bipartisan success this Congress.

Thank you for this opportunity. I look forward to your questions.

[The prepared statement of Mr. Powell appears on page 84]

Chairman SANDERS. Mr. Oliver, thank you very much.

Our final witness is Richard Powell, executive director—oh, Jesus, I am sorry. That is it.

Senator GRAHAM. I wanted to hear it again.

Chairman SANDERS. All right.

Mr. POWELL. I am happy to take another turn.

[Laughter.]

Chairman SANDERS. All right. I think we are ready for questions.

Let me begin by asking Mr. Wallace-Wells a question. If we do not act and act extremely aggressively, tell us what the future of our country and planet will look like.

Mr. WALLACE-WELLS. Well, the answer to that question is covered with several layers of uncertainty, so if we decarbonize rapidly, the climate system may still prove more sensitive than we expect, which could bring more warming than we would like. But taking as sort of a baseline that our best models are good indications of where the climate is heading, we are globally—it has been estimated by some of the best people studying this—on track for about 3 degrees of warming. That means that we have a long way to go to get to 2 degrees and below 2 degrees, which is what the scientific community and—

Chairman SANDERS. David, you know, to the average person, 3 degrees, so what? What is the problem? It is a little bit warmer. What is the impact in our country and around the world? What does 3 degrees mean?

Mr. WALLACE-WELLS. Well, we could see war doubling. We could see crop yields falling by at least 20 percent, maybe 50 percent. We could see migration in the tens of millions. We could see cities all across South Asia become so hot that you could not walk around outside without risking death. As a result, you would see, again, huge mass migrations. The effect on economic productivity even in the northern latitudes, places like the U.S., would be quite dramatic. There would be extreme weather hitting, you know, events that used to hit every 50 years, every 100 years, hitting every single year. And the number of billion-dollar disasters that would be

accumulating even in places like the United States would be quite intense. Those impacts are all going to hit parts of the world and then within individual countries hitting parts of those countries, hitting those people hardest who are least able to respond, hitting the poorest, the marginalized, and really straining our ability to promise a future of prosperity and justice and equity to future generations.

Chairman SANDERS. Okay. Thank you very much.

Dr. Litterman, as you know, Wall Street is continuing to invest hundreds of billions of dollars in the fossil fuel industry. Why are they continuing these investments despite the costs laid out by Mr. Wallace-Wells and Professor Stiglitz?

Mr. LITTERMAN. Yeah, the problem is that those costs are not internalized. These are external costs, and so what, you know, businesses do, what investors do is they look for opportunities to make profits given the incentives that they have. The problem is we have a bug in the Tax Code. We are not creating the appropriate incentives to reduce emissions, and this problem is a problem that needs to be identified—I mean, it needs to be addressed by Congress.

When I chaired the CFTC Climate-Related Market Risk Subcommittee, we had unanimous agreement that the most important and most urgent recommendation, Recommendation 1 out of 53 that we made, is that we put a price on carbon. And that is because all the participants in the financial markets understand how efficient they are at moving capital to where there are opportunities to make money. That is what we do. And it is given the incentives that we have. We have the wrong incentives. This is actually very simple to fix. You have to give the private sector the appropriate incentives to reduce emissions, and then they will all be moving in the right direction. Right now we are all moving in the wrong direction because we have the wrong incentives.

Chairman SANDERS. Okay. Thanks very much.

Dr. Stiglitz, economics has been thought of as the “dismal science,” and we are doing a lot of dismal discussion today. But there is, I think, some positive aspects about transforming our energy system. Can you talk about what moving aggressively away from fossil fuel to energy efficiency and sustainable energy would mean in terms of our economy and the creation of good jobs?

Mr. STIGLITZ. Very much. I wanted to emphasize that there actually is a real opportunity to transform our economy, create enormous value. You know, one of the issues is—and it was emphasized by other people in this hearing—that if you have more efficient buildings, you save over the long term an enormous amount of money and resources that can go to other uses, that the cars that are electric last a long time. And at the same time, for the next 10, 15 years, we are going to be creating an enormous number of jobs as we create the green infrastructure that we need, and we are also going to have jobs at a higher level where we are creating the R&D and, as we create that R&D, also emphasize that our ability to export the new technologies to make this a global effort to reduce carbon emissions will earn us a lot of money.

So this is one of those areas where we are going to be doing well by doing good if we can create these new technologies. There is

going to be a strong global demand for these new technologies, and that plays to our long-term strength.

Chairman SANDERS. Thank you very much, Dr. Stiglitz.

Senator Graham.

Senator GRAHAM. Thank you very much.

Mr. Oliver from Johnson Controls, the Business Roundtable supports a price on carbon. Is that correct?

Mr. OLIVER. A price on carbon. That is correct, Senator.

Senator GRAHAM. And does the U.S. Chamber support that?

Mr. OLIVER. The Business Roundtable put a price—you know, we think that a market-based—

Senator GRAHAM. Do you know if the Chamber supports it or not?

Mr. OLIVER. I am not sure, Senator.

Senator GRAHAM. So, Mr. Powell, what percentage of carbon emissions come from the United States in terms of the world?

Mr. POWELL. We are now down to about 15 percent of global emissions.

Senator GRAHAM. Okay. If we put a price on carbon, what happens if China and India do not?

Mr. POWELL. It will not have an effect on decreasing Indian and Chinese emissions, and China emissions are now about double our emissions.

Senator GRAHAM. Do you agree with that, Mr. Wallace-Wells?

Mr. WALLACE-WELLS. Well, a tax here will not have an effect abroad, but many of those countries are already signaling an interest in investing in clean energy that goes beyond ours, so they may yet move faster than we expect.

Senator GRAHAM. I guess what I would say is that we need to probably move together, because one of the concerns that people have is if we put a price on carbon here, it could create a competitive disadvantage, at least in the short term.

What would you say to that, Mr. Wallace-Wells?

Mr. WALLACE-WELLS. I think the world is shifting on some of these questions such that we do not think about decarbonization as a cost but an opportunity, and I think that is especially clear with the air pollution data that I cited. Because that is local, the costs are concentrated within national borders, and it means that the incentives to decarbonize are true for every country everywhere in the world.

Senator GRAHAM. Agreed. Do you support an increase in the gas tax to fund the Highway Trust Fund?

Mr. WALLACE-WELLS. I do not have a particular opinion on that policy question.

Senator GRAHAM. What about you, Mr. Powell?

Mr. POWELL. I think we are going to need multiple sources of revenue to increase the Highway Trust Fund, especially as we move more to electric vehicles. The gas tax will not be able to do it alone.

Senator GRAHAM. Do you also support the idea of an electric vehicle paying into the Highway Trust Fund somehow?

Mr. POWELL. I think we will need to do that if we want to maintain our infrastructure.

Senator GRAHAM. Okay. So now that is different than an economy-wide price on carbon. I talked to the Climate Leadership Council yesterday, and I have talked to Senator Whitehouse a lot about this. What you do with the money is really important. If you rebate it to the consumer, it lessens some of the fears that people have about increased cost at the gas tank, increased heating costs, you know, running your business.

So the bottom line for me is I know it is a problem, and everybody is sort of looking at each other on my side. You all have gotten solutions that I do not think can get there. It is a 50–50 Senate. But if the Chamber—you have got the Business Roundtable. I am just talking from a Republican point of view. We are going to do a hearing, Mr. Chairman, on electric vehicles, right? We hope so?

Chairman SANDERS. Yeah.

Senator GRAHAM. See, I have got BMW and Volvo in South Carolina. Senator Stabenow is at sort of the heart and soul of the car business. And it seems to me that all the people making cars are indicating that they are going to go to a non-internal combustion car. And I think they are doing that for multiple reasons. When the biggest car companies in America are beginning to change their fleet, I would like to find out why they are doing that and what can we do on the production side, energy efficiency side, sort of to lead the world, not just shame them but actually make money in a lower-carbon economy.

So to Senator Whitehouse, who has been a true leader in all of this, we will sit down and talk about a 50–50 Senate, what is possible, but I would like to start a discussion that maybe can bear fruit over time here and get the Business Roundtable and other groups on the business side that support a price on carbon, find out what kind of rebate is fair that will get you the most political support. So from my point of view, it is inevitable that we are going to a lower-carbon economy. That is a good thing.

I would end with this one thought. Do you all agree that it would be a nightmare for the Ayatollah and Putin if we went to a lower-carbon economy anytime soon?

I will assume silence means yes. Okay, thank you.

Senator WHITEHOUSE. I will stipulate to that from my position.

Chairman SANDERS. Thank you, Senator Graham.

Senator Stabenow.

Senator STABENOW. Yes, and I would stipulate to that as well. I want to thank, Mr. Chairman, you and our Ranking Member, and I want to thank Senator Graham. I want to say “ditto” in terms of the discussion we need to have around electric vehicles and manufacturing and where we go. It is all about jobs, good-paying jobs, as well as energy independence. It is how we get the energy for the electricity as well. That becomes very, very important. But it is absolutely true that our American automakers are moving toward an all-electric fleet. And, in fact, General Motors (GM) has said that by 2035, Ford is doing the same thing. What I find exciting is that they are now looking at—they are going to be rolling out their large profit center vehicles like the F–150 truck or the Chevy Silverado as electric. And so we are seeing the large what would be carbon emitters now becoming electric as well as, interestingly,

I was at the unveiling of an all-electric Hummer last week, which was also very exciting to see where they are going. So count me in on all of that as well as supply chain and manufacturing and all the things that we can do to help the economy.

I want to talk, though, with my agriculture hat on. I am Chairwoman of the Agriculture, Nutrition, and Forestry Committee, and I am hearing all the time from farmers and ranchers and foresters, of course, natural disasters getting worse and worse and worse. They are right at the front of all of this. We see crops being destroyed. We see all kinds of challenges because of the climate crisis as well as water issues and a whole range of things in the Great Lakes.

But the producers on the front lines also know that they can be a part of the solution, and, in fact, they are already sequestering carbon, but we can develop policies to support them, to help them do it even more, to create a way for them to be able to have a revenue source from selling carbon credits. I believe that they are ready to do that, very anxious to ramp up their conservation efforts.

I have several bipartisan bills that really drive this transition, two with Senator Braun on the Committee. One of those, the key bill, Growing Climate Solutions, I want to thank Senator Whitehouse and Senator Graham for also being our bipartisan cosponsors on an approach through the U.S. Department of Agriculture (USDA) to really activate what we can do with agriculture and forestry.

And so I would very much like to hear from all the panelists or any that wish to respond, speak to the need not only to reduce emissions from electricity and transportation, but also to find new ways to cheaply pull carbon pollution out of the air through things like agriculture and forestry. I would welcome your comments. Mr. Wallace-Wells, would you like to go first?

Mr. WALLACE-WELLS. Well, it is a crucial part of the equation. Agricultural emissions are a significant contributor to the warming that we see, even though most Americans probably do not appreciate that. And as you say, American farmers and farmers all around the world have been very much, you know, hit in the face with extreme weather. I believe in several of the last few years American farmers have actually made more money on insurance payments than they have made on their crops, and that is a devastating harbinger of the future.

In terms of the solution side, you know, soil can be used and plants can very truly be used to have an effect on our overall emissions. I think that there is an opportunity there that we have not yet seized, although, as you say, some farmers are moving in that direction. I think that we need to do more than just price carbon to push that along because, you know, I am glad to know that fellow witnesses and other Senators here agree that pricing carbon higher is effective, but I would emphasize that those impacts are different from sector to sector. And while they are very helpful, especially in power and electricity, they make less of a difference to the bottom line of farmers. And I would like to see more emphasis on agricultural policy, regulation, and investment in R&D to help

those farmers do better and farm more responsibly rather than relying simply on the crude impact of a carbon tax.

Senator STABENOW. Yes, sir?

Mr. POWELL. I think this broader topic of carbon dioxide removal is extremely important, and I thank you for your leadership on these strategies. I think we should remember that many, many of the goals that large companies have made have been net zero emission goals, so that means they will bring their emissions down as far as possible and then rely on other offsets or removal technologies. Obviously farms and forests can play a huge part of that solution. We will probably need technological solutions as well or even hybrid models which contain the carbon dioxide removal characteristics of biological systems with technical systems to permanently sequester that CO<sub>2</sub> underground.

I think one of the things that you could do immediately on this, in addition to things like the Growing Climate Solutions Act, is also make sure that the demonstration programs for carbon dioxide removal that were included in the Energy Act of 2020 are fully funded through the appropriations process. Thank you.

Senator STABENOW. Yes, absolutely. Thank you.

I know I am out of time—

Mr. STIGLITZ. Let me—

Senator STABENOW. I would love to hear from others, I guess, if we can take a moment. Yes?

Mr. STIGLITZ. Let me just emphasize the complementarity between the incentive systems that are provided by credits, which I think are very important, with the investments in R&D and regulations that help direct attention toward better farming practices, and that terrestrial carbon, the carbon that is sequestered in the soil and in plants, is a very important part of our systematic approach to addressing climate change. About 20 percent of all carbon emissions are related to deforestation and other agricultural practices. So your emphasis on agriculture is really very important.

Senator STABENOW. Thank you. And if any—

Mr. OLIVER. Yes, and I would agree—excuse me. Senator, I would agree with that. We had a healthy discussion on this recently.

Senator STABENOW. Yes.

Mr. OLIVER. And as I have learned more, I think as we think about from a Business Roundtable standpoint, carbon dioxide removal technologies are going to be critical in the overall goal to get to net zero carbon emissions. And I think when we think about a price on carbon, this is going to be one of those critical elements that we are going to take a look at or make sure it is incorporated into the overall structure.

Senator STABENOW. Thank you.

Chairman SANDERS. Okay. Thank you, Senator.

Mr. LITTELMAN. And, Senator, if I could just add, first of all, I agree with all the other witnesses, and I would just make one other observation, which is that what we need is innovation. And when governments pick, you know, strategies or technologies to support, they are making the choices. When we set up the incentives through a pricing system, every entrepreneur, every business,

every investor has an opportunity to try and figure out which is going to be the best solution.

Chairman SANDERS. Okay. Thank you very much.

Senator Whitehouse has been a leader on this whole discussion, and, Sheldon, if you need a couple minutes more, please take it.

Senator WHITEHOUSE. Great. Thank you, Chairman. I appreciate it very much, and I want to thank you for holding this hearing. And I particularly want to thank the witnesses that we have. We have, I think, one of the most impressive panels of witnesses that have ever gathered on climate change in this United States Congress. So I am really grateful to you all for being here.

I did want to make one point before I got to my questioning, and that is where I think we are in terms of getting to a solution, and it relates back to some of what Mr. Oliver has said. The economic risks that we are talking about are many. They are profound. They are deeply dangerous. And I have sent to every single colleague in the Senate quite some time ago this volume which contains 17 of the most serious warnings of economic crash that are out there. Economic crash can be viewed as the carbon bubble bursting. It can be viewed as coastal property values collapse. It can be viewed as uninsurability, knocking the bottom out of the insurance industry. And there is no reason that those three cannot all happen in a cascade of economic collapse.

So these are really dire warnings, and nobody except Democrats got back to me. I sent these with a personal note. No one. And I remember when I first got here, Senator Sanders and I were in the same class; we came at the same time. Senator Graham was here then. For our first 3 years here, there was a lot of bipartisanship on climate change. By my count, there were four efforts in the Senate, all bipartisan, all serious. And our friend Senator McCain, as the Presidential candidate of the Republican Party, campaigned on a strong climate platform. That was where we were.

Then in January of 2010, all of that bipartisanship stopped dead as if it had hit a wall. It was like watching an echocardiogram go dead when the patient went dead. What happened? What happened was Citizens United in January of 2010. When Citizens United, when the five Republican appointees who opened the flood gates to unlimited money in politics made that decision, the fossil fuel industry instantly went to work to take advantage of that new power. And since then, they have run, through secret money, behind front groups, across a whole variety of election manipulation strategies, a consistent effort to undermine Congress' ability to address climate change, with the result that since Citizens United, no Republican Senator has since gotten onto any serious economy-wide piece of climate legislation. None. Zip. Zero.

What the fossil fuel industry has done in our politics makes me think of Winston Churchill's phrase many years ago of committing a crime that has no name. And I think history will look back on the covert operation run by the fossil fuel industry against its own country to debilitate and incapacitate our own Government from addressing this problem as one of history's vilest political acts. And that is why we are where we are right now, and the corporate community is starting to stand up now. Business Roundtable (BRT) is starting to stand up. Climate Leadership Council (CLC) is starting

to stand up. But I will tell you, as somebody who sits in Congress, that the corporate presence on this issue is still net negative. Even if you take out the fossil fuel industry's continued efforts from behind front groups and with dark money to stop progress, even if you remove all of them, the remaining sectors of corporate America are still net negative.

It is telling that neither Ranking Member Lindsey Graham nor Mr. Oliver know what the position of the U.S. Chamber of Commerce is on a price on carbon. It shows that their statements that they nominally support one are sure nominal. And I can tell anybody who is listening that my colleagues on the Republican side, which is where the pressure has been focused, do not see any countervailing pressure to worry about from anywhere in corporate America, not from Wall Street. They have got a big lobbying apparatus; it is not deployed on this. Not from Silicon Valley. TechNet's performance on climate politically has been a disgrace. Not from the agricultural sector, not from big ag. Not from the consumer products lobbies. Nobody from corporate America who touches Congress directly is expressing any interest in getting anything done on climate. And I will tell you that when the BRT has a meeting or the CLC has a meeting and they make a statement or an announcement or they send a letter to President Biden, all that is good. But if it is not touching Congress, it does not have effect in Congress. And time is running out for corporate America, if it really cares about this issue, to tell its damn lobbyists and trade associations to take it seriously.

The discrepancy between what corporate America tells the public about its attitude on climate change and what it tells Congress about its attitude on climate change is a disgraceful discrepancy. Every major American corporation ought to do an independent audit of its own lobbying and electioneering and political influence efforts in the last decade, and I think CEOs will be very surprised to find where their companies' footprint is on climate change, because I suspect that it will very often be exactly adverse to their stated public position. Talk about sustainability. That is not sustainable.

So that is the point I wanted to make. If that changes, a lot of gateways open, and the measure of when that has changed is when a Republican Senator or Member of Congress will stand up and say, "I am behind this bill. Here is something I will stake my flag on. I am behind this bill that is an economy-wide carbon measure."

So that is the statement I wanted to make. I appreciate it.

I have two questions. The first is for Professor Stiglitz, who I am really honored is here. I admire so much his testimony in the young persons lawsuit, his affidavit. Professor, the International Monetary Fund has calculated the subsidy in the United States of America for fossil fuel every single year—every single year—at \$600 billion, billion with a "B," \$600 billion every year supporting the fossil fuel industry just in the United States. And, obviously, a number like that is based on what economists call "negative externalities," the harm that fossil fuel emissions cause that does not get baked back into the price of the product, which Milton Friedman and the most conservative economists would all agree is

a fatal economic problem that needs to be addressed. And yet we do not address it because of the fossil fuel industry's power.

My question for Professor Stiglitz is: When you have got a \$600 billion subsidy out there operating in favor of an industry, if you have not offset that with a price on emissions, what effect does that continuing effective subsidy have on the economy's ability to make the necessary transition to clean energy ahead of climate calamity? Professor.

Mr. STIGLITZ. Absolute wrong direction. It actually encourages the use of fossil fuels. It makes fossil fuels more competitive than they should. You know, the basic principle that everybody has talked about of a price on carbon, what this is is a negative price on carbon. When you are subsidizing carbon, you are encouraging the emissions of greenhouse gases.

And so the first order of business should be eliminating the negative price on carbon that we have been having. That is really the first order of business, and that is why at the beginning of the hearing you said you were going to take actions to get rid of these subsidies it was such an important measure.

Senator WHITEHOUSE. Professor, if I could interject one second, is there any doubt in your mind that negative externalities count as a subsidy and belong in that pricing calculus you just described?

Mr. STIGLITZ. Absolutely no doubt in my mind that what is going on here is that we are subsidizing something that is having a negative effect on our economy. It is going in absolutely the wrong direction, and—

Senator WHITEHOUSE. And since I am over my time already, I am going to jump quickly to my last question, which is to Dr. Litterman, who has made his career assessing risk for Goldman Sachs. And Goldman Sachs I do not think tolerates ideology in its risk assessment. It wants to make money, and it only makes money if it gets its risk assessments right. So the premium on accuracy of risk assessment is something that Dr. Litterman has lived with at the highest levels of the American investment community, and from that perspective, I want to ask him how urgent—how urgent is it right now that we respond to this climate risk?

Mr. LITTERMAN. Senator, I am glad you asked that question. The reality is we do not know how much time we have. And with respect to the cost of delay, let me tell you a story from my experience. Years ago, my wife and I were driving on the freeway when she exclaimed, "Oh, my God, Bob, watch out." From her tone, the urgency in her voice, I knew instantly I had to pay attention. She had spotted across the divider about a quarter of a mile in front of us an oncoming 18-wheeler bouncing out of control and spewing flames from the passenger side wheel well. I remember immediately slamming on the brakes, even before I had realized, as my wife already had, that the truck was not going straight, as I had thought, but was actually careening diagonally right toward us, which is what had terrified her. Five horrifying seconds later, we managed to avoid by a fraction of a second plowing head-on into a gasoline tanker that had exploded right where we would have been. That quick response to my wife's warning saved our lives because I was able to safely steer the car through the fire and out the other side.

We are today, with respect to climate action, in the same position I was when my wife sounded her warning. A growing chorus of scientists, CEOs, national security experts, and financial experts have all seen climate change barreling toward us, and they are shouting, “Watch out.”

Senator WHITEHOUSE. Thank you, Mr. Chairman.

Chairman SANDERS. Senator Braun.

Senator BRAUN. Thank you, Mr. Chair.

So in listening to everything before I got here, I think I can give an update on what the state of the climate is, especially in the U.S. Senate. I got here a little over 2 years ago, and I know that a Climate Caucus was being attempted to be formed for several years. And when Chris Coons asked me probably within about 6 months of being here, he told me how hard it was to get that bipartisan discussion going. It was very easy for me. I have been a lifelong conservationist, have been into the idea of how we keep Mother Earth in good shape, have practiced it in my own agricultural involvement, both row crops and as a tree farmer. And there is more buy-in than what you can imagine out there.

When you look at this place, which seems to resemble more the Hatfields and McCoys, in the year and a half we have had the Climate Caucus, in the probably 20-plus meetings that we have had, it was the most engaged subject, and I am even more interested in reforming health care, but there was no discussion on that because the industry, the health care industry, is not interested in changing itself. It is the biggest part of our economy that is broken, and it is the existential issue of costing, as Warren Buffett describes it, being a tapeworm on the economy.

The good news is, in climate, the stakeholders are interested. I was with ConocoPhillips this morning, Commons Engines riding in my own hometown talking to their CEOs, and you cannot believe how interested they are in being part of the solution. And I do not want to overly generalize, but in that year and a half, almost everyone that heads up a major company—and that is not just in the emitters of transportation, electric generation, industrial, about half of which is in two areas, steel and concrete. Farming, we could set the example across the world because we emit—about 10 percent of our footprint is agriculture. What most folks do not know across the world, that is a much larger contributor, means there is a lot of marginal improvement you can make there. So the state of the discussion is better than what most might imagine.

In my own conference, when it took 2 years to get one to step forward, I did it. There are now six others, including Ranking Member Lindsey Graham. And we have made a lot of headway. When you look at the other component that has got to fall in place on my side of the aisle, you have got to get grassroots support, and I can tell you there young conservatives, young Republicans, faith-based, from evangelicals to Catholics, farmers—farmers especially because if there is any business that is high risk, low return, that now not only has the routine weather but the anomalies that all have measured, they are interested. And being on a Committee that seems to be the least partisan that I am aware of, and I am on it, Agriculture, Senator Stabenow said that we have got a bill. And I think the way this works is you have got to get something

across the finish line. The Growing Climate Solutions Act, which we put a lot of effort into, rewards farmers, tree and egg, for good stewardship. And there are voluntary markets out there to reward it. That is just a start, and I think that has got a good chance of making headway this year.

So I have a question for each of you, Mr. Wallace-Wells and Mr. Powell. The biggest question in the room is: How do you pay for it? The Chairman and I would have agreement on things that we need to accomplish here, and we are going to probably be divergent on how you do it, especially in an institution that has got the poorest balance sheet I have observed in the history of the country, actually. That does not mean that you cannot always borrow more money and do things, but that is not sustainable. Climate and sustainability go hand in hand.

I would love to hear the ideas of how we do this and pay for it, and I am hoping it is not that the Federal Government is the only stakeholder in this. I would like to hear what you think about voluntary markets becoming a bigger deal, and I asked both Chairs today could a pricing market happen within a voluntary, you know, paradigm. So address that and any other ideas on how we pay for it. Mr. Wallace-Wells, you go first.

Mr. WALLACE-WELLS. Well, what I would say first is that I think especially when we are talking about decarbonizing the electricity sector, the costs there are genuinely negative, that we will be better off as a country in relatively short order if we move quickly.

I mentioned during my prepared remarks that the NRDC calculates that the benefits of the Clean Air Act are \$3 trillion annually. That alone would be enough to have paid for the Coronavirus Aid, Relief, and Economic Security (CARES) Act of last year, the Biden jobs plan this year, and similarly sized investments every single year going forward. I think when we are talking about that transition, we can do well very quickly by moving fast.

Some other sectors of emissions are a little bit more complicated and a little bit hard to pay for. I think there is some room for voluntary payment. If you think about, you know, paying for a carbon offset to cover an airline ticket, so long as those offsets can be verified, that is useful. But, in general, I think we have to stop thinking personally about the cost of action on climate as being enormous, and start thinking about the cost of inaction as being considerably higher. And it is from my perspective the view—it should be the view of a body like this and indeed in the United States Government generally to be making sure that those investments line up rather than taking a narrow or shortsighted view about up-front costs and not considering the payments that will be coming back to us in relatively short order.

Senator BRAUN. Thank you. Mr. Powell?

Mr. POWELL. Thank you for the question, Senator Braun. Thank you for your leadership on the bipartisan Climate Solutions Caucus, on the Nuclear Energy Leadership Act, on the Growing Climate Solutions Act. You have really dug in here, even in your just short time so far in the Senate.

As we have discussed, the reason we remain so focused on innovation policy is we really see that as more investing than spending. The benefits we have seen from innovation policy, which is rel-

atively low in cost compared to some other interventions, just have extraordinary returns. If you look at the benefits we have seen in the U.S. economy due to the shale gas revolution, both due to domestic improved air quality, lower carbon emissions, lower energy costs, and now the geopolitical security that our domestic shale gas revolution has provided to us globally, we think that those benefits from that investment in increased tax dollars, in lower geopolitical risk, and improved air quality in the United States far outweigh the relatively modest costs we made in that innovation investment. Thank you.

Senator BRAUN. Thank you, and we are moving in the right direction, so I hope the public understands that.

Thank you.

Chairman SANDERS. Senator Warner.

Senator WARNER. Thank you, Mr. Chairman. Thank you for holding this hearing. I think it is good to hear my colleague Senator Braun and others acknowledge this enormous challenge. We have lots of members talk about an issue like this that climate change poses. I see it well from the intel side, and I see it from the national security side. We have talked a little bit about the—Dr. Stiglitz talked about the jobs opportunity side.

One area that I do not think has gotten enough attention, and I am going to pose my first question to Dr. Litterman—

Chairman SANDERS. Mark, it is a little bit hard to hear you. Could you raise your volume there?

Senator WARNER. Yes, thanks. I said a bunch of good things about you, Bernie, that I am probably—

Chairman SANDERS. All right. Then repeat them several times. [Laughter.]

Chairman SANDERS. No, you are better now.

Senator WARNER. Let me get straight to the question, which is I think one other tool that we have not fully utilized is this emerging field around ESG, environmental, societal, and governance standards for public enterprises. I think increasingly we are seeing investors want to see bottom-line investments. I think increasingly we are seeing workforce and customers look to corporations to see how responsible they are going to be on issues like resilience. I think the Securities and Exchange Commission (SEC) needs to be involved in this. I was happy to see that Apple recently endorsed mandatory disclosure of greenhouse gas emission at the SEC.

Dr. Litterman and Dr. Stiglitz, can you talk about if we simply made resilience or climate change, an effect on climate change a material reportable item, what effect that might have on moving corporations, many of which, I think, actually want to lean that way—at least their CEOs say they want to lean that way, but we have not given them the regulatory signal that this is appropriate?

Mr. LITTELMAN. Yeah, well, thanks for that question. I would say, look, the reporting of material risks is already required. That is not the issue. The issue is what climate-related risks are material. And I see that, you know, on the CFTC climate-related market risk report we had unanimity we do have to report material risks. The question is, for climate risks, they are very different than traditional financial risks. Traditional financial risks, we have a history; we have a distribution of potential outcomes, and we can ask

corporations what will the impact be on their balance sheet. And then we can decide through a stress test is this very significant or not. With climate, we are talking about business plans that go decades into the future.

Now, you are right that a huge number of corporations have already said we see the future, it is going toward net zero emissions, and we have a plan to be there. But how do you know as an investor, as an asset owner, is that business plan on target? You know, what are the goals that are going to be achieved in the next 5 years, for instance? So corporations and the private sector have to work with the financial regulators. And I am really thrilled to see the response from the regulators. The Fed has joined The Central Banks and Supervisors Network for Greening the Financial System (NGFS); the SEC has asked for input about disclosure; the CFTC has talked about moving in this direction as well.

So I am not worried about the financial sector and about the regulatory environment. They are all going in the right direction. The problem is we do not have the right incentives. This regulatory framework will disclose risks, and investors will be able to understand the risks facing corporations. But it is the systemic risk to society that will not be addressed by financial regulation. It has to be addressed by Congress, by setting the right incentives in place to reduce emissions, and by globally, you know, harmonizing those incentives so that China and India and Europe all have the same incentives that we have to reduce emissions. And if we do that, I am very optimistic that we will get the innovation we need; we will get to that net zero economy and hopefully soon enough to avoid the worst effects.

Mr. STIGLITZ. Let me put it in a little bit broader economic terms. You cannot allocate resources efficiently if you do not have information, and one of the key aspects of information is the risks that a company faces. So it is very important that there be as full a disclosure on a comparable basis of those risks. And we talked to some of those risks today. We talked about the change in the prices of their assets when we reassess the value of a whole variety of assets, once we start pricing carbon in. There are risks to property values. Insurance companies face risks of losses. Banks face losses in the nonrepayment of certain classes of carbon when they become stranded assets. So one of the things we have to do is work towards broader standards so we can make those disclosures comparable.

But a second thing is, from a regulatory point of view, just like we saw in 2008 that there are systemic risks that we did not fully appreciate when we looked at a bank-by-bank point of view and now we are looking at stress tests that look at how the whole financial system operates, the carbon risk is not only in the financial system, it is throughout our economy. And so we have to begin to do systemic risk not only in our financial system, not only our banks, our insurance companies, but more broadly. And the regulators have to take a lead in making those risk assessments and making those risk assessments available so that investors know exactly how fragile certain parts of the economy are.

Senator WARNER. And I would simply say—I know we have gone over my time, Mr. Chairman. I, again, appreciate you having this

hearing. But I think this is an area where we could build a broad coalition. This ESG movement is a good movement. It has been too squishy to date. We need to have some set standards that cut across all industries. Financial Accounting Standards Board (FASB) and other groups have been working on this for years. It really needs some extra effort, and my hope is that the new regulatory regime is coming around to make this happen.

Thank you, Mr. Chairman.

Chairman SANDERS. Thank you very much, Senator Warner.

Senator MERKLEY.

Senator MERKLEY. Thank you very much, Mr. Chairman, and thank you all for your testimony. As I went to vote, I missed some of what you might have said, so if I bring up something repetitive, my apologies.

I wanted to start with, Mr. Litterman, as you reemphasized, the right incentives, and maybe one of the wrong incentives are the tax subsidies that we currently provide for fossil fuels, and today is the day that Chairman Sanders is introducing the End Polluter Welfare Act and several of us are cosponsoring it.

Have you done any sort of calculation of how essentially reducing all those incentives might compare to a price on carbon? Can you translate eliminating those subsidies that exist in the law now, American law, to kind of dollars per gallon or dollars per ton of carbon dioxide?

Mr. LITTERMAN. Well, we start with the fact that, of course, you want to eliminate the subsidies to fossil fuel production and consumption, and you want to take a comprehensive look at all of the incentives that are there, both subsidies and taxes. And when you look at that, I would say the subsidies to the fossil fuels are—you know, they are there, but they are not large relative to the incentives that we need on the other side to reduce emissions. We need strong incentives. As I said, we have to act quickly, and we have to have strong incentives.

The way I would look at it is if we put a ton of carbon dioxide in the atmosphere today, we are very likely to have to pull it out at some point in the future, and that is an expensive proposition. So we need strong incentives. It is not just that we need to reduce subsidies. We absolutely do. But we need strong incentives.

Senator MERKLEY. I wonder if you could fill us in on perhaps how much eliminating those current tax incentives might translate to, and, Professor Stiglitz, I do not know if you have done that kind of calculation either.

Mr. STIGLITZ. I have not, but let me just emphasize that this is a no-brainer. There is what we call “low-hanging fruit” that you just wonder, you know, if we push the world in the wrong direction, it is hard sometimes to pull it in the right direction. But stopping pushing in the wrong direction seems to me a place where everybody can begin by an agreement.

Senator MERKLEY. All right. Thank you. I wanted to turn to another piece of the puzzle, and often we are talking about the demand side in terms of going to more fuel-efficient vehicles, going to electric vehicles, improving our buildings and so on and so forth. But there are some of us that feel it is important to emphasize the supply side as well. Two examples of that are not building new fos-

oil fuel infrastructure and another is keep-in-the-ground concept where the fossil fuels that we own as citizens, we do not pull out of the ground. And there are three kind of basic arguments about this. One is reduce the stranded assets. If there are less assets out there—and you have all—several of you have spoken to the stranded assets argument.

A second is once you build the infrastructure—and, for example, there is the potential Liquefied Natural Gas (LNG) facility in Oregon and the pipeline to connect to it to export LNG. Once you build it, there is a huge incentive to keep it operating, and there are huge profits from that that go back into the political lobbying and the existing jobs and so forth. So there is a feedback loop that makes it hard and slows the transition to renewables.

And the third is that in terms of partnering with the world—and we have a worldwide problem here. If we are not willing to keep our fossil fuels in the ground, if we are not willing to stop building our new fossil fuel infrastructure, then how do we have the moral kind of position to ask other countries to take action when it would affect jobs and sometimes in far poorer countries, places that need the economic development much more than—they are more desperate than we are.

So there are kind of three arguments there, and I just thought I would ask both of you, Mr. Litterman and Professor Stiglitz, if you think there is merit in those arguments.

Mr. STIGLITZ. Oh, very much so, and let me emphasize that the decisions that we are making today affect us 20, 30, 40 years from now when we are talking about infrastructure. So that is why those decisions are so important now that we are locking ourselves into technologies that will continue, you might say, to plague us for decades to come, and then present an economic problem when they become stranded assets. They are going to wind up on our balance—and the Government is going to bail it out, I can assure you. And so those are hidden debts that are going down that we are going to be accruing.

Your point about more relief around the world I think is also very important. There are a lot of concerns, for instance, about the deforestation in Brazil, about people are keeping this oil in the ground, and we ought to be providing incentives for them to do it. There is a rainforest coalition trying to keep the forests in Brazil and Borneo there, which is very important for climate change. But we lose our moral force when we do not take actions.

And here let me say one more thing, which is regulations can be very simple. People often complain regulations are burdensome. You just have a regulation, no coal-fired, fossil fuel-fired electric generating plant be constructed. A very easy regulation to write and to implement.

Senator MERKLEY. The simplicity of keep-in-the-ground is no new leases. You do not sign new leases, leases which often are exploited for decades, sometimes up to 50 years.

Mr. STIGLITZ. Exactly.

Senator MERKLEY. My time is now up, so, Mr. Litterman, I apologize. I asked you for your response, but I will probably have to take that offline unless the—

Mr. LITTERMAN. No, I think Professor Stiglitz answered well. Thank you.

Senator MERKLEY. Okay. Thank you very much.

Chairman SANDERS. Senator Merkley, thanks very much.

Senator Van Hollen.

Senator VAN HOLLEN. Thank you, Chairman. Thank you to all our witnesses here today. Professor Stiglitz, thank you for first talking about the huge costs of doing nothing to address climate change, costs that we are experiencing right now around the country, including in my State of Maryland where we have rising sea levels. The historic sort of boat show in Annapolis, Maryland, has been threatened by floods, and that is just one example. But also thank you for focusing on the huge economic opportunities and job opportunities of moving immediately and quickly into a clean energy economy.

On that score, I have been working for years to establish what we used to call a “green bank.” This is a clean energy accelerator, a financing authority that would be publicly capitalized, but then it would be self-sustaining. And the idea would be to mobilize a lot of private capital and have that multiplier effect.

Senator Markey and I have introduced a bill called the “National Climate Bank,” also runs as the clean energy accelerator, if people prefer to call it that, and I was pleased to see that the President, President Biden, in his American Jobs Act included \$27 billion to capitalize that. We proposed \$100 billion. We hope to get it there. But I was really glad to see this is part of the President’s plan.

Can you comment on that initiative as part of an overall effort to move in this direction?

Mr. STIGLITZ. I think it is very important. I have been a strong supporter of green banks, green development banks. And, you know, bipartisan, there is now a broader understanding of the role of industrial policy that the financial market often does not do well in the long-term support that you need, and particularly when there is what we call an “externality” associated with green.

My concern is it is a little too small—or much too small. It needs to be scaled up. I even think that your bill may be too small when you compare, for instance, what some other countries have done. The European Investment Bank is an EU investment bank, and one of their main mandates is green investment. And they are bigger than the World Bank, and they are really focusing now on that kind of green transition, and if we want to remain competitive, we have to devise ways of making sure that we have the finance for investment. And let me say one of the things I like about your bill, I think it needs to be—this kind of finance has to be done at the national level, at the State level, the community level. And so thinking of a framework that allows for that kind of greening institutions at these multiple levels—here in New York State we have a successful green bank, but, of course, it needs to be expanded as well. Within its confines, it has been doing well. But having this as a national program would be fantastic.

Senator VAN HOLLEN. Well, thank you. You know, years ago we had an initiative like this included in a bill that passed the House back in, goodness, 2009 or 2010, but that did not make it through the Senate. So I was glad to see many States move forward, like

New York, in establishing the green banks. But the idea here, as you said, is to really do this at the national level. If you can help us get this—increase the capitalization above even \$100 billion, that would be great.

Another initiative I have been working on for over a decade is putting a price on carbon but doing it in a way that would make sure that any higher costs passed along do not hurt or burden lower-income or middle-income families. And the proposal was a cap and dividend. You put a cap on the first sellers of carbon-intensive polluting fuels into the market and then dividend 100 percent back to consumers based on Social Security numbers.

Mr. LITTELMAN, can you just talk briefly about that approach and, if we have time, Mr. OLIVER as well.

Mr. LITTELMAN. Sure, it is a great approach. The Climate Leadership Council plan also has a carbon dividend, and the beauty of the carbon dividend is it makes most people better off, in particular, those at the lower end of the income strata. So it makes sense. It is a good policy. Again, how you spend the money is up to Congress, but what is absolutely essential is to create the appropriate incentives so that the private sector gets behind this and the capital flows at the scale that we need and at the urgency we need. So, absolutely, I support it.

Mr. OLIVER. And, Senator, if I could go back and talk a little bit about the green banks, for us we think that is a great idea. As we launch our performance contracting and our private-public partnerships, it is a great way to be able to finance green projects and what we can do to upgrade infrastructure and buildings. We have a performance contracting business, as I mentioned in my remarks, that hopefully is going to be economic—create economic returns. So what can we do to make green infrastructure while creating returns?

And as far as the Business Roundtable does not endorse a specific market-based mechanism to reduce emissions, we do believe placing a price on carbon would send an important price signal that will help drive efficiency and spur innovation in low-carbon alternatives. And there are various mechanisms that can be used, and we do believe and are in agreement that the comprehensive climate change policy should be guided by core principles, including preserving the competitiveness as well as effectively reducing emissions. And a price on carbon can and should be designed in a way that it supports economic growth and does not disadvantage Americans, particularly low-income Americans and those whose jobs and communities are affected by the transition to a clean energy economy.

Senator VAN HOLLEN Well, thank you. I see my time is up, but I would just emphasize the point that you and Mr. LITTELMAN made, which is actually the overwhelming majority of households actually have more money in their pocket at the end of the day if you do the 100 percent dividend than before. In fact, over 70 percent of households are better off under a University of Massachusetts, Amherst study.

Thank you all very much. Thank you, Mr. Chairman.  
Chairman SANDERS. Thank you, Senator Van Hollen.  
Senator Padilla.

Senator PADILLA. Thank you, Mr. Chair. I appreciate all the witnesses and their participation today.

Let me dive right into an urgent matter for the country, but particularly my home State of California. 2020 was devastating on so many fronts, including being California's worst wildfire season on record. California experienced 10,000 fire incidents with more than 4.2 million acres burned, more than 10,000 structures damaged or destroyed. We will continue to have record wildfire seasons unless we take bold action to address climate change. And according to the U.S. Forest Service, wildfires will be twice as destructive by 2050 as they are today, and we know wildfires are just one of the emerging climate-driven threats to our economy.

Climate change is increasing the frequency and severity of various types of natural disasters and extreme weather events which create significant risk to human health, our financial system, and entire sectors of the economy. So with that being said, a question for Mr. Wallace-Wells and one for Dr. Litterman.

Mr. Wallace-Wells, beyond the physical damage, can you elaborate on how wildfires have a devastating impact on human health and how climate change will continue—if you can just add to what you previously said, how climate change will continue to exacerbate the harm and destruction caused by wildfires and other natural disasters. And then for Dr. Litterman, a specific question about the National Flood Insurance Program, which paid out more than \$1 billion in claims for the sixth year in a row, meanwhile flooding increased in areas known as being “low risk.” So this is just one way that climate-driven disasters are creating a fiscal risk for the Federal Government specifically, and if you could discuss the need to mitigate these risks to help protect the Federal budget and our economy. Mr. Wallace-Wells first.

Mr. WALLACE-WELLS. There is basically no aspect of human health that is not damaged by small particulate pollution which is produced by wildfires, and I think most Americans, first of all, do not truly appreciate that when forests burn, carbon is released, which means already the gains of California's ambitious clean energy proposals and policies are undone almost every year by the emissions released by those fires, but also that all those many millions of Californians who live in that State are breathing in air that affects their respiratory health, that affects Alzheimer's, that affects developmental disorders, that affects autism and attention deficit hyperactivity disorder (ADHD) and associated with rises in schizophrenia. You know, the effect of pollution is so intense that when we instituted E-ZPass toll plazas in America, they reduced the rates of premature birth and low birth weight right around those toll plazas by between 10 and 15 percent just because people living around them were not breathing quite as much air from the exhaust of those cars.

I think this is one of the great underappreciated features of climate change and the climate impacts, is the effect of air pollution. In California, there was a small-scale unintended study when there was a pollution event that forced schools to put air purifiers in their classrooms, just \$700 air purifiers, and the educational gains of breathing in cleaner air was equivalent to halving the class size in those classrooms. That is how horrible to cognitive performance

bad air is, and the more wildfires will be burning, the more Americans will be breathing that air going forward. You mentioned a doubling of wildfires. The scientists I know think that we could see six times as much or more by the middle of the century if we do not take action. And, unfortunately, one significant way of taking action is by doing what is called “prescribed burning” and “thinning of forests,” which I think is a good idea, but also involves the burning of forests, which will also produce carbon and also produce particulate pollution.

So as with many other features of the climate crisis, there is not anymore an easy way out. We have already backed ourselves into a corner where we are choosing between worst alternatives. But I think in the American West the pollution from wildfire will become a bigger and bigger part of our understanding of the climate crisis and a bigger argument for faster action.

Mr. LITTELMAN. Senator, I happen to be sitting here in California, and if you can see this window behind me, September 9th of last year that was pitch black this time of day because of the smoke from the wildfires. And the insurance issue that you raise is an important one. The impacts from climate are going to be more severe over the next several decades, no matter what we do. And individuals and businesses should insure against those physical risks.

The problem is that they are going to become more expensive. If you are living in the forests in California, insurance rates are going to go up. In a free market economy, that increased rate of insurance is a signal that you either have to harden your infrastructure, your buildings, or you have to move to a safer location. And the same thing with flood insurance that you mentioned. The Federal flood insurance is a subsidy to those who live in flood zones. That is not right. That gives the wrong signals, and people will respond to the signals they get.

Once again, I want to emphasize how fundamental incentives are. Incentives are anything that change behavior, and so if you want to change behavior, and we do need to change behavior because of the physical risks that we have created, then you have to create the appropriate incentives. Thank you.

Senator PADILLA. Thank you both.

My time is up. Thank you, Mr. Chair.

Chairman SANDERS. Thank you very much, Senator Padilla.

As we come to a close, let me thank the five panelists. Without exception, I think your contributions were enormously important. I think there is a growing sense of understanding that in this country and around the world we are facing an existential threat, and that is, we are literally talking about the future of this planet. We are talking about whether or not we are going to have to spend trillions and trillions of dollars trying to repair the damage done by climate change. We are talking about millions of people dying unnecessarily. So I hope that this hearing today makes a contribution to understanding that together we have got to act, and act extremely aggressively, and to act in as quickly a fashion as we possibly can.

With that, as information for all Senators, questions for the record are due by 12:00 noon tomorrow with signed hard copies de-

livered to the Committee clerk in Dirksen 624. Email copies will also be accepted due to our current conditions.

Under our rules the witnesses will have 7 days from receipt of our questions to respond with answers.

With no further business before the Committee, this hearing is adjourned. Thank you all very much.

[Whereupon, at 12:57 p.m., the Committee was adjourned.]

**ADDITIONAL MATERIAL SUBMITTED FOR THE RECORD**

[Prepared statements, responses to written questions, and additional material submitted for the record follow:]

## PREPARED STATEMENT OF MR. WALLACE-WELLS

**Written Testimony of David Wallace-Wells**  
**Editor at Large, *New York* magazine**  
**Author, *The Uninhabitable Earth: Life After Warming***

**Hearing on “The Costs of Climate Change**  
**United States Senate Committee on the Budget**  
**April 15, 2021**

In the last calendar year, 2020, what was called at first the novel coronavirus killed, according to the CDC, 350,000 Americans.<sup>1</sup> Air pollution from the burning of fossil fuels is not novel, but according to one recent estimate published in the journal *Environmental Research*, it also killed, in the last year for which data are available, 350,000 Americans.<sup>2</sup> A covid-level mortality event in the midst of what appeared to most of us, overlooking the cost of burning fossil fuels, an unexceptional year.

The numbers are so large they can seem almost hard to credit, and they may yet be revised—though it is a distressing fact of climate science that almost all revisions push estimates of damage, and therefore the cost of inaction, upward. This is a familiar paradox of climate science, which offers harrowing assessments and projections which we know — must know — also offer the clearest picture we have of the future that awaits us should we fail to act. In fact, we are already living with many of those impacts, often having insidiously normalized them. Globally, the same research suggested, 8.7 million deaths in 2018 can be attributed to pollution produced by the burning of fossil fuels.<sup>3</sup> That attribution is complex, and the deaths multi-factorial, meaning they are hard to untangle from other contributing factors we often call comorbidities and know reflect enduring disparities: poverty, poor health care and housing quality, underlying medical conditions. On all of these fronts, climate change and environmental degradation promise to worsen disparities, punishing those most intensely who are least able to endure and adapt.

Those punishments are harrowingly widespread. The *Lancet* puts the global annual death toll of all pollution at 9 million.<sup>4</sup> This is dying at the scale of the Holocaust every single year. In India, where 349,000 stillbirths and miscarriages have been attributed annually to the effects of air

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<sup>1</sup> [https://covid.cdc.gov/covid-data-tracker/#trends\\_totalandratedeathstotalrate](https://covid.cdc.gov/covid-data-tracker/#trends_totalandratedeathstotalrate)

<sup>2</sup> Karn Vohra et al, “Global mortality from outdoor fine particle pollution from fossil fuel combustion: Results from GEOS-Chem,” *Environmental Research* 195 (2021).

<sup>3</sup> Vohra 2021.

<sup>4</sup> *The Lancet Commission on Pollution and Health* 2017.

pollution<sup>5</sup>, the average resident of Delhi has had his or her life expectancy shortened by more than 9 years from the repetitive inhalation of smog.<sup>6</sup> Globally, the average figure is two years.<sup>7</sup>

In the United States, thankfully, we have enviable air quality. The Clean Air Act of 1970 is still, according to the National Resources Defense Council, saving 370,000 American lives every single year.<sup>8</sup> As a result, the NRDC says, that single piece of legislation delivers annual economic benefits of more than \$3 trillion, 32 times the cost of enacting it—benefits distributed disproportionately to the poor and marginalized, who had previously suffered most from pollution (as they always do).<sup>9</sup> That estimate of benefits is so large it could have covered the cost of the CARES act last year, and the Jobs Act this year, and paid for similarly-sized investments in the future well-being of Americans every single year hereafter. But, unfortunately, many of these gains could be undone by air pollution produced by growing American wildfires over the next few decades.

In 2020, wildfire smoke accounted for more than half of all air pollution in the western U.S., meaning that more particulate matter from fire infiltrated the lungs of Americans living in those states than from all other industrial and human activity combined.<sup>10</sup> The smoke reached the East Coast, too,<sup>11</sup> then traveled to Europe<sup>12</sup>, which shouldn't surprise us, considering that smoke from the Australian fires from earlier in the year — which burned 46 million acres, stopping ferry service in Sydney harbor, setting off fire alarms in the city's downtown office buildings, and forcing beachside military evacuations in scenes reminiscent of both *Dunkirk* and *Mad Max* — could be seen via satellite traveling as far as South America.<sup>13</sup>

Now, at the tail end of a brutal pandemic year, those Australian fires may seem like a vague and distant memory, but they are also a harbinger of our global future. There are those who downplay the problem of wildfire in the American west by suggesting that the dramatic growth in acres burned — a quadrupling over four decades<sup>14</sup>, with five of the six largest fires in the state's modern history all arriving in 2020<sup>15</sup> — is not the simple result of climate changes but also a half

<sup>5</sup> Tao Xue et al, "Estimation of pregnancy losses attributable to exposure to ambient fine particles in south Asia: an epidemiological case-control study," *Lancet Planetary Health* 5 (2021).

<sup>6</sup> Michael Greenstone and Claire Qing Fan, "Air Quality Life Index 2020 Annual Update."

<sup>7</sup> Greenstone 2020.

<sup>8</sup> "Clearing the Air: The Benefits of the Clean Air Act," May 2020.

<sup>9</sup> "Clearing the Air: The Benefits of the Clean Air Act," May 2020.

<sup>10</sup> Marshall Burke et al, "The changing risk and burden of wildfire in the United States," *Proceedings of the National Academy of the Sciences* 118 (2021).

<sup>11</sup> Mike Baker, "Smoke from West Coast Wildfires Spreads to the East Coast," *New York Times*, September 15, 2020.

<sup>12</sup> Andrew Freedman, "Western wildfire smoke nearing Europe, may be on an around-the-world journey," *Washington Post*, September 16, 2020.

<sup>13</sup> "Australian bushfire smoke affecting South America, U.N. reports," *Reuters*, January 7 2020.

<sup>14</sup> Burke 2021.

<sup>15</sup> Michael McGough, "5 of the 6 largest California wildfires in history started in the past 6 weeks," *Sacramento Bee*, September 22, 2020.

century of poor forest management, which has left behind a state full of what Californians have tragically learned to call “fuel.” Those people are right, to a degree: better forest management can help mitigate the damage from future fires, though even the prescribed burns favored by experts to “thin” that fuel load would produce air pollution just as wildfires do—and would require perhaps 20 million acres, or 20 percent of the state, to be burned or thinned.<sup>16</sup> And while it is also the case, as skeptics sometimes point out, that California once saw much bigger fires in its distant pre-Columbian past, it is also true — critically true, since on all of these questions we are not just dealing with natural systems but the matter of human response and human consequences — that there weren’t 40 million people living there, then, either, breathing all that toxic air, and pushed by the state’s housing crisis to live further and further into what’s called the “wildland urban interface,” where fire risk is highest. Since 1990, sixty percent of all new residential development in the state has come in wildfire-prone areas.<sup>17</sup> Nationally, we are adding a million new homes to the “WUI” every three years.<sup>18</sup> When the Camp Fire incinerated Paradise, California, evacuees settled in nearby Chico—straining an already-strained housing supply, driving up homelessness, and sparking a political backlash to those new arrivals whom locals began calling “refugees,” and “unwanted,” though they came from less than fifteen miles away, chased by flames.<sup>19</sup>

This is where we are today, with birds falling from the sky by the thousands in the American southwest, emaciated by climate change<sup>20</sup>, and clouds of locusts eight thousand times bigger than they would have been without warming descending on croplands in the horn of Africa, chewing through enough food to feed millions<sup>21</sup>; with a category 5 hurricane making landfall in Nicaragua just two weeks after, and just fifteen miles from, a previous category 4<sup>22</sup>; and Houston hit by five of what were once called “five hundred year storms” in just five years.<sup>23</sup>

This term has lost much of its meaning in a time of rapid warming, and was often invoked imprecisely before. But its vernacular use is a powerful reminder of just how far we have come from what our grandparents, or even our parents, would have recognized as “normal.” Five hundred years ago, there were no European settlements in North America. Hernando Cortez had just landed in Mexico. A “500-year storm” is therefore a storm of such severity it would be

<sup>16</sup> Rebecca K. Miller et al, “Barriers and enablers for prescribed burns for wildfire management in California,” *Nature Sustainability* 3 (2020).

<sup>17</sup> Patrick Sisson, “Maps show where wildfires have burned over and over again in LA county,” *Curbed*, January 22, 2019.

<sup>18</sup> Burke 2021.

<sup>19</sup> Naomi Klein, “Forged in Fire: California’s Lessons for a Green New Deal,” *The Intercept*, November 7, 2019.

<sup>20</sup> Phoebe Weston, “Mass die-off of birds in southernwestern U.S. ‘caused by starvation,’” *The Guardian*, December 26, 2020.

<sup>21</sup> Rina S. Khan, “Record Locust Swarms Hint at What’s to Come With Climate Change,” *EOS*, July 14 2020.

<sup>22</sup> Associated Press, “Dangerous Hurricane Iota Makes Landfall on Nicaragua Coast,” November 16, 2020.

<sup>23</sup> Amal Ahmed, “Tropical Storm Imelda Will Likely Be Southeast Texas’ Fifth 500-Year Flood in Five Years,” September 20, 2019.

expected to hit, on average, just once during that entire history—the arrival of Europeans on American soil, the waging of a genocide against its native peoples, the building of colonies and the fighting of a revolution, the building of a slave empire and the fighting of a civil war, industrialization and the Great Depression, World War I and World War II, Jim Crow and the Civil Rights movement, the Women’s movement and gay rights movement, the Cold War, the end of the Cold War, the “end of history,” the internet, September 11 and 2008. One storm of that scale in all that time, is what we were told to expect. The area of Houston was hit by five of them in five years—literally millennia of extreme weather, compressed into the span of just half a decade. The immediate cost of just one of those storms, Hurricane Harvey, has been calculated at \$90 billion—three times higher than the estimate of climate damages offered by William Nordhaus’ Nobel-prize winning DICE model for the entire country that entire year.<sup>24</sup> Continued warming does not herald a “new normal,” however often the phrase has been deployed, but the end of normal—never normal again.

Now, Houston is still standing, of course, and most of California is, too, and we are still here today, debating what measures to take to stall the growth and blunt the force of climate change—all a sign that the impacts of warming aren’t the whole of our destiny, but instead form the natural landscape on which our future will be built, and indeed contested. Humans are adaptable, and resilient, and innovative—though we can also be cruel, ruthlessly nationalistic and punishingly prejudiced. And while society offers countervailing forces, of course — benevolence, generosity, solidarity in times of crisis — it is easy to fear that other set of impulses growing more intense over time, as intuitions about resource scarcity and the threat of extreme weather drive mass migration and give credence to a zero-sum view of the world. Already, as we live only with the known knowns of present warming, the climate obstacles to equitable human flourishing — and to promises of justice and prosperity and global cooperation we would hope to extend to future generations — are of an unprecedented scale.

Today, the planet is, by most estimates, about 1.2 degrees Celsius warmer than the pre-industrial average we use as a baseline. That number, 1.2, doesn’t sound like much, but it already places us outside the window of temperatures that enclose the entire history of human civilization, which means that everything we have ever known as a species — from the invention of agriculture through the making of the modern nation state and the forging of an international order — was erected upon climate conditions which no longer prevail. The last time there was as much carbon in the atmosphere as there is today, NOAA recently reported, was 3.6 million years ago.<sup>25</sup> There were no humans then. The planet wasn’t 1.2 degrees warmer, but 3. The arctic was full of forest. The seas weren’t rising by centimeters; they were almost 80 feet higher.

<sup>24</sup> Gernot Wagner, “In a summer of extreme weather, climate costs remain unclear,” *Bloomberg Green*, June 17, 2020.

<sup>25</sup> “Despite pandemic shutdowns, carbon dioxide and methane surged in 2020,” *NOAA Research News*, April 7, 2021.

The crudest prediction would be that what happened then will, more or less, happen now—though some impacts, like sea level rise, would take centuries to unfold. But the science is considerably more cautious, offering a picture of unchecked warming that, while unmistakably distressing, is also shrouded by several layers of uncertainty. There is some uncertainty in the science itself—whether 2 degrees of warming will destroy all the planet’s coral reefs, depriving a billion people of a major food source, for instance, or just the vast majority of those reefs. There is also some uncertainty about the sensitivity of the climate—whether, given a doubling of pre-industrial carbon concentrations, say, the planet warms by 2 degrees or 5. And there is twofold uncertainty about the human response, as well: how quickly will we draw down our use of carbon, and how capably, how equitably, how justly and how ambitiously we adapt to the devastating impacts of climate, which will hit the poor and the marginalized much more intensely, exacerbating and intensifying existing disparities and injustices, both within countries and globally.

But uncertainty is not — should not be, cannot be — an argument for inaction, as our slow-footed pandemic response shows all too well. And we do know in which direction the climate is headed. We also know the terrifying speed. Today, carbon is being added to the atmosphere at a faster rate than at any point in the history of the planet, which includes several mass extinctions powered by such dramatic carbon-driven climate change that the overwhelming majority of life on earth died out. By most estimates, the present rate of increase is at least ten times faster.

Climate change isn’t only fast when viewed from the perspective of deep time. You may think that global warming is a long process, initiated at the beginning of the industrial revolution, with impacts accruing slowly over centuries—this was how I long understood it, as the work of ignorant grandparents whose impacts would be felt by innocent grandchildren. But half of all the emissions produced from the burning of fossil fuels in all of human history have come in just the last 25 years. That is since Al Gore published his first book on warming, and since the U.N. established its I.P.C.C. climate change body. It is since the premiere of *Friends*. Climate responsibility — for the present crisis, and for preventing its worsening in the future — is alive on the planet today. It is in this room. I am not an old man—38 years old. Almost two thirds of all carbon emissions ever produced in the history of humanity have been produced in my lifetime. A quarter of all that damage has been done since Joe Biden was elected Vice President in 2008. About a third has come since Senator Graham first joined the Senate. To pull us up short of what has often been characterized as a catastrophic level of warming — 2 degrees — requires decarbonization at least as fast, and perhaps faster.

If we don’t? The landscape of possibility projected by science is, while uncertain, inarguably alarming. At just two degrees of warming, the IPCC has suggested, flooding events that

would've once happened once a century could arrive instead every single year.<sup>26</sup> The land burned annually by fires in the American west is expected to at least double, and perhaps grow six-fold.<sup>27</sup> And because there is a natural limit on the amount of heat and humidity the human body can endure — the measure is known as “wet-bulb temperature” — cities across the Middle East and South Asia that are today home to millions would routinely be so hot during summer you couldn't safely go outside, and certainly couldn't work outside for long periods, without risking heat-stroke or possibly death.<sup>28</sup> In Calcutta, according to work published in *Nature Climate Change*, the number of days featuring what we now consider lethal heat could grow by between a quarter and a third from a baseline fifty years ago, to almost 200 days every year by 2050. In Miami, the number could double from a baseline drawn just in the year 2000, to 100 days annually; in Jakarta, 240.<sup>29</sup> At two degrees, the number of deaths from air pollution could grow by 150 million.<sup>30</sup>

At three degrees, yields of key crops could fall by 20% or more without intervention and adaptations<sup>31</sup>; some have warned of reductions as high as 50%.<sup>32</sup> Droughts used to hit once a century could hit every two to five years, and those that used to last months could now last years.<sup>33</sup> Those who study the relationship between temperature and conflict suggest that, at three degrees, war could double<sup>34</sup>—and as Vice President Kamala Harris recently said, while past wars were often fought over oil, future ones may be fought over water. (Actually, she said “will.”)<sup>35</sup> Estimates of the aggregate economic impact of unmitigated climate change vary widely, with some older models suggesting an impact of just a few percentage points, and others offering much higher estimates: compared with a world without warming, between 15-25% of per capita global output would be lost, according to one much-cited paper, between 2.5 degrees and 3 degrees of warming.<sup>36</sup> That is an impact bigger than the Great Depression, and, effectively, permanent, and the authors suggest that keeping warming to 1.5 degrees — as opposed to 3 —

<sup>26</sup> “Special Report on the Ocean and the Cryosphere in a Changing Climate,” U.N. IPCC, 2018.

<sup>27</sup> “Fourth National Climate Assessment,” 2018.

<sup>28</sup> Fahad Saeed, “Deadly heat stress to become commonplace across South Asia already at 1.5C of global warming,” *Geophysical Research Letters*, March 10, 2021.

<sup>29</sup> Camilo Mora et al, “Global risk of deadly heat,” *Nature Climate Change* 7 (2017). The authors prepared an interactive tool to explore heat risks anywhere on the globe for Carbon Brief. The data described here show days of deadly heat under a “moderate mitigation” (or RCP4.5) scenario for 2050, and the tool can be found at [carbonbrief.org/billions-face-deadly-threshold-heat-extremes-2100-study](https://carbonbrief.org/billions-face-deadly-threshold-heat-extremes-2100-study).

<sup>30</sup> Shindell et al, “Quantified, localized health benefits of accelerated carbon dioxide emissions reductions,” *Nature Climate Change* 8 (2018).

<sup>31</sup> Chuang Zhao et al, “Temperature increase reduces global yields of major crops in four independent estimates,” *Proceedings of the National Academy of the Sciences* 114 (2017).

<sup>32</sup> David S. Battisti and Rosamond L. Naylor, “Historical Warnings of Future Food Insecurity with Unprecedented Seasonal Heat,” *Science* 5911 (2009).

<sup>33</sup> G. Naumann et al, “Global Changes in Drought Conditions Under Different Levels of Warming,” *Geophysical Research Letters* (2018).

<sup>34</sup> Marshall Burke et al, “Climate and Conflict,” *Annual Review in Economics* 7 (2015).

<sup>35</sup> Mary Rose Corkery, “Kamala Harris Says Wars Will Be Fought Over Water ‘In a Short Amount of Time,’” *Daily Caller*, April 7, 2021.

<sup>36</sup> Marshall Burke et al, “Large potential reduction in economic damages under U.N. mitigation targets,” *Nature* 557 (2018).

would save 10-12% of global GDP. In the United States, another estimate runs as follows: “With continued growth in emissions at historic rates, annual losses in some economic sectors are projected to reach hundreds of billions of dollars by the end of the century—more than the current gross domestic product of many U.S. states.”<sup>37</sup> That estimate isn’t drawn from the r/collapse subreddit, or the talking points of Extinction Rebellion, or even the policy briefs of Sunrise. It is from the National Climate Assessment, intended to guide the climate policy of this body, and this country.

Just a few years ago, it seemed prudent to plan for scenarios at higher temperatures than three degrees—four degrees, five degrees. Thanks to a global political awakening, growing cultural pressure, and rapid, once-unthinkable improvements in the cost of renewables, those scenarios now appear, most scientists believe, considerably less likely. According to analysis by Climate Action Tracker, current global policies and trajectories will probably bring about 3 degrees of warming; factoring in new pledges lowers the figure about half a degree from there.<sup>38</sup> This is good news, though those are just paper pledges, at this point, and much more must be done, and much faster, to bring the world below two degrees. And even that new, measured optimism is shrouded in uncertainty, as well: we could decarbonize rapidly and still end up unfortunately north of two degrees, if the climate proves more sensitive than we expect. If we don’t accelerate our ambition, we could get “unlucky,” and end up at four degrees, perhaps even more. In that world, global mortality rates from climate change could be five times those of COVID-19—even when “adaptation” is factored in.<sup>39</sup>

And our adaptive response is just as clouded by uncertainty as the sensitivity of the climate system: though we flatter our own predictive powers with precise models of future economic growth, we have very limited ways of modeling technological progress, public investment and policy, especially deep into the future. In fact, adapting to two degrees may ultimately prove a taller, more disruptive, and more expensive task than limiting warming to that level. Even today, we are paying much more to respond to disasters than to prevent them, and the farther north we get, beyond two degrees, the more the needs and the costs will grow, too, along with the level of human suffering: more sea walls; more migration, both managed and unmanaged; more air filters and cooling centers, more hospitals and firefighters and flood insurance and farm insurance, all efforts to protect humanity and project prosperity equitably into an uncertain future.

As any investor or economist would tell you, uncertainty itself is a cost—and I’m very glad that Bob Litterman is here today to discuss the risk management, and risk mitigation, costs of warming. Investors and economists would also tell you that foregone benefits are a cost,

<sup>37</sup> “Fourth National Climate Assessment,” 2018.

<sup>38</sup> [climateactiontracker.org/global/temperatures](https://climateactiontracker.org/global/temperatures)

<sup>39</sup> Tamma Carleton et al, “Valuing the Global Mortality Consequences of Climate Change Accounting for Adaptation and Benefits,” *National Bureau of Economic Review Working Paper No. 27599* (2020).

too—and this is, I think, the biggest news on climate, that the benefits of decarbonization, once considered trivial by contrast, are in fact enormous.

On this, we have passed a tipping point. For a generation, climate action was too often seen as a purely moral or humanitarian burden. It will be that: a challenge to all the world's nations to be good stewards of the planet, of their citizens, and indeed of the citizens of other nations, who may be made, by the impact of warming, more desperately in need. But it no longer makes sense to talk about decarbonization as an expensive undertaking to be weighed against that moral burden. In fact, quite the opposite: the cost of climate action is now almost certainly negative. Last year, Duke's Drew Shindell testified before the House of Representatives that a total decarbonization of the American electricity sector would be entirely paid for by the public health benefits of cleaner air.<sup>40</sup> The IMF has calculated that the unpaid environmental costs of fossil fuels amount to an annual global subsidy of over \$5 trillion<sup>41</sup>—we don't need to keep paying that. The International Energy Association recently called solar power the "cheapest electricity in history,"<sup>42</sup> and in many parts of the world it is already cheaper to build out new clean energy capacity than to continue running existing dirty-energy infrastructure; by 2030, new renewables are expected to be cheaper than 96% of existing coal power.<sup>43</sup> In the short term, simply decarbonizing the country's electricity sector, it's been estimated, could create millions of jobs we'd be effectively losing by sitting on our hands. America's coal industry today employs 43,000 workers<sup>44</sup>, our oil and gas business employs 135,000.<sup>45</sup> One report, perhaps optimistic, puts the number of jobs created by a rapid program of electricity decarbonization at 25 million.<sup>46</sup> New infrastructure, new industry—these will bear fruit for decades, as will the necessary innovation in solar cells and batteries and perhaps even nuclear power and negative emissions, all of which can be effectively exported globally, as well, delivering an American share in a new, greener, global economy. We know now, in ways we didn't just a few years ago, that that economy is coming, and fast, because this same logic seems to apply all around the world, with ambitious new net-zero commitments being made this last year, during the pandemic and independent of any international pressure, by South Korea, Japan, the E.U., and, most significantly, China. They all see the gains to be seized; do we? I'm very glad that Joe Stiglitz is here today to discuss the limits of conventional economic accounting of climate impacts. Personally, I don't believe most of those models adequately reflect the costs of inaction, either, biased towards easily quantifiable outcomes and historical precedent and away from extreme events and the unprecedented risks of

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<sup>40</sup> Testimony of Drew Shindell, "The Devastating Health Effects of Climate Change," House Committee on Oversight and Reform, August 5, 2020.

<sup>41</sup> David Coady et al, "Global Fossil Fuel Subsidies Remain Large: An Update Based on Country-Level Estimates," IMF 2019.

<sup>42</sup> *World Energy Outlook 2020*, IEA 2020.

<sup>43</sup> "Powering Down Coal," Carbon Tracker, 2018.

<sup>44</sup> [https://www.bls.gov/oes/current/naics4\\_212100.htm](https://www.bls.gov/oes/current/naics4_212100.htm)

<sup>45</sup> <https://www.bls.gov/iag/tgs/iag211.htm>

<sup>46</sup> Saul Griffith and Sam Calish, *Rewiring America*, 2020.

an unprecedented climate. And yet, even using those models, rapid decarbonization still comes out very much on top and in the black.

That bargain will only last for so long. Climate change is not binary; each tenth of a degree matters. But the opportunity to pull up short of catastrophic warming, and help deliver the world to a relatively comfortable landing, is closing quickly. This is a generational responsibility, and an immediate one. If the world had begun decarbonization in the year 2000, carbon emissions would only have had to fall by a couple of percentage points a year to safely avoid two degrees of warming. Now, the number is almost ten percent. Wait a decade and it will grow to 25% or more. How little would we have to feel we owed future generations to not act now? How blind would we have to be to our own best interest, to calculate only the costs of decarbonization and not its benefits? How short-sighted and how narrow-minded would we have to be, to overlook returns arriving as soon as later this decade, to accept the intensification by climate of already painful inequalities, or to define the suffering of those living elsewhere in the world as so insignificant we remained unmoved by it, even though moving would be in our best interest, too? I hope we aren't forced to learn the answers to those questions.

Thank you.

PREPARED STATEMENT OF MR. LITTERMAN  
STATEMENT OF ROBERT B. LITTERMAN, PHD  
CHAIR, CFTC CLIMATE-RELATED MARKET RISK SUBCOMMITTEE  
CONCERNING  
“THE COST OF INACTION ON CLIMATE CHANGE”  
DELIVERED TO  
UNITED STATES SENATE COMMITTEE ON THE BUDGET  
APRIL 15, 2021

*Introduction*

Chairman Sanders, Ranking Member Graham, and members of the Committee: Thank you for inviting me to address the risks that climate change poses to the economy and my suggestions for how to deal with them. The best science shows that damage from climate change is already serious, and could range in the future from severe to catastrophic. Risk of this magnitude demands an immediate ambitious response, including a price on carbon. Today the world is hopeful for U.S. leadership on climate action, but appropriate management of climate risk requires action by this Congress.

When the stakes are high, as they are with our planetary future, uncertainty often compels more action rather than less. And in the presence of such large risks, delay in responding is costly. We need to act — immediately and forcefully. Thankfully, the solutions we need to manage these risks are at hand; in particular, a clear, strong price signal will let markets function efficiently and effectively to reduce emissions. A carbon price can be equitable, bipartisan, and the core of effective climate response.

*Background*

My name is Bob Litterman. I am an economist by training and have spent my career managing financial risk. I worked at Goldman Sachs for 26 years. I was a partner and head of our firmwide risk department. I am now the chair of the risk committee at Kepos Capital, and I sit on several boards for groups that study and propose responses to climate risk, including the Climate Leadership Council, which I co-chair with Kathryn Murdoch; the Niskanen Center, which I chair; Ceres; Climate Central; Resources for the Future; the Stanford Woods Institute for the Environment and the Stanford Natural Capital Project; the Woodwell Climate Research Center; and the World Wildlife Fund.

**Section 1: Lessons from Financial Risk Management**

Financial risk management has several simple principles that apply to managing climate risk. Most importantly, risk management requires imagining “worst case” scenarios, by which we really mean scenarios that are extremely bad, but plausible. When I took over risk management

at Goldman, we would analyze scenarios where markets would lose half their value overnight. In such an extreme event, would we have enough capital to open in the morning?

Risk managers do not only worry about expected outcomes. Our job is to prevent disasters. This means that we must look at the full distribution of potential future outcomes and evaluate how changes in policy could hedge against bad outcomes. Identifying the worst-case scenario for climate risk is challenging because we are performing this experiment for the first time, it is practically irreversible, the impacts will be felt for many decades to come, and we must make judgements about how society will respond to large physical changes. I am pleased to provide testimony today alongside David Wallace-Wells because he has done exactly that with respect to climate change and done so in remarkably humane terms.

Another principle of financial risk management, which is perhaps not as obvious, is that our objective is not to minimize risk, but to price risk appropriately. In the private sector, risk managers make sure that risks are identified and only taken when the reward is commensurate. For example, at Goldman Sachs we would charge traders for the risks they took, forcing them to take risks only where the firm would be more than compensated by the expected returns on their trades.

With public policy, the objective is to use prices to incentivize the right level of insurance against bad outcomes. Without pricing, we would either be too cavalier in the face of oncoming disaster, which describes our current approach to climate change, or paralyzed by an inability to accept some risk as the normal course of things. Neither is necessary in this context. I am also pleased to provide testimony alongside Professor Stiglitz, because he is a Nobel laureate in economics, and I am quite sure that he can explain better than I the importance of incentives in directing the flow of capital and why failing to force economic actors – the fossil fuel industry, manufacturers, and consumers – to pay a price for the climate risk to which we are all exposing ourselves is extremely dangerous.

A third principle of risk management is that time is a scarce resource. If we have enough time, we can solve almost any problem. It is when time runs out that a risk becomes a catastrophe. The risk from climate change is increasing as we fill the atmosphere with greenhouse gases. We do not know how much time we have before we cross a tipping point, or multiple tipping points, after which unmanageable disaster becomes inevitable. This is an extremely urgent matter and the cost of inaction mounts year over year as climate risks loom larger.

Explaining how uncertainty affects risk management decisions in everyday terms, I often use the analogy of cycling in the mountains, one of my favorite forms of exercise. Imagine two scenarios: In the first scenario you are riding down a road you know well. Up ahead you know that there is a dangerous hidden curve with a sharp drop-off. Since you know the road well, you know where to start braking, and how fast you can safely go around the curve. Given this knowledge, you would ease on the brake well ahead of time, using maximum pressure right before you enter the curve.

Now consider a different scenario, in which you have never been down this road before. Because of your uncertainty about the road you realize you need to be more cautious. You have not eased

onto the brakes by the time you spot the hidden curve, and you realize you might be going too fast. So you brake hard. The intent is not to stop, but to go into the curve with more control and more options. You may even let up on the brakes as the curve reveals itself. Aware of the curve, but uncertain of its shape, is where we are with respect to climate risk. We have seen the curve ahead and are going too fast.

And with respect to the potential cost of delay, I remember a specific incident from my own experience. Years ago (on December 6, 2014), my wife and I were driving on the freeway when she exclaimed “Oh my God, Bob — watch out!” From her tone, the urgency in her voice, I knew instantly I had to pay attention. She had spotted, across the divider about a quarter of a mile in front of us, an oncoming 18-wheeler, bouncing out of control and spewing flames from the passenger-side wheel well. I remember immediately slamming on the brakes, even before I had realized, as my wife already had, that the truck was careening diagonally right towards us, which terrified her. Five seconds later we narrowly avoided, by a fraction of a second, plowing head on into a gasoline tanker that had exploded right where we would have been. That quick response to my wife’s warning saved our lives because I was able to safely steer our car through the fire and out the other side.

We are today, with respect to climate action, in the same position I was when my wife sounded her warning. A growing chorus of scientists, CEOs, national security experts, and financial experts have all seen climate change barreling toward us. They are shouting “Watch out.”

## **Section 2: The Implications of Climate Risks for the Financial System and Economy**

Last year, I had the honor of serving as the chair of the Commodity Futures Trading Commission’s Climate-Related Market Risk advisory subcommittee. The CFTC is responsible for regulating the derivatives markets in the United States to ensure “integrity, resilience, and vibrancy.” Members of the subcommittee included representatives of market participants — banks, institutional investors, non-financial corporations, and a commodity exchange — as well as academics and nonprofit organizations. We focused on the principles of risk management outlined above, and that led to a clarity of vision that allowed us to create, and unanimously support, a detailed road map for managing climate risk in the U.S. financial system.<sup>1</sup>

That road map focuses on two types of climate-related financial market risks. First are the specific risks, for example to individuals and corporations, from increasingly extreme weather events such as storms, wildfires, and sea-level rise that are expected to increase in number and intensity over the next 50 years. Specific risks are growing over time, but are manageable. The second type of risk, which I will come back to, is systemic risk to society.

Specific risks take many forms. For example, in the Western U.S., scientists have established a link between the area burned by wildfires and climate change, which creates dry and warm conditions amenable to large wildfires.<sup>2</sup> This has clear implications. We have recently seen the

<sup>1</sup> U.S. Commodity Futures Trading Commission, “[Managing Climate Risk in the U.S. Financial System](#),” September 9, 2020.

<sup>2</sup> John T. Abatzoglou and A. Park Williams, “[Impact of anthropogenic climate change on wildfire across western US forests](#),” *PNAS*, 113, no. 42 (October 2016): 11770-11775.

Southwest experiencing record wildfire seasons, exacerbated by both land management practices and climate change.<sup>3</sup> The confluence of those factors has real costs. The CFTC report highlights the case of Pacific Gas and Electric in California, which entered bankruptcy because of \$30 billion in liability associated with its infrastructure sparking record wildfires. Meanwhile, the effects of climate change loom even larger in the future.

Another example is flooding incidents in coastal regions brought about by sea-level rise. This is a visible and accelerating manifestation of global warming.<sup>4</sup> Higher sea levels increase the risk of damaging floods in coastal areas, whether they are driven by tides, storm surges, or other weather events. Markets are already starting to respond to this increasing risk, with detectable changes in prices due to perceived flooding risk. This portends significant financial risks, as we reported to the CFTC, “Declining real estate values — driven by climate-related impacts or the perception of such impacts in the future — could substantially depress economic activity. Some populations and local communities within the United States may ultimately be required to relocate, with potentially significant economic losses for households and investors.”

Lastly, scientists in recent years have begun to identify how climate change has affected individual weather extremes. Last January, the American Meteorological Society published its annual update to an ongoing series of reports, *Explaining Extreme Events of 2019 from a Climate Perspective*, which found climate linkages to large fires in Alaska, the extreme rainfall associated with hurricanes, and heat waves.<sup>5</sup> All of them were from 2019 alone. The report is released each year. As the symptoms of climate change develop, they will continue to increase risks to infrastructure and economic activity.

The distinguishing feature of specific risks is that they can be insured against, and, of course, they should be. Insurers can diversify exposure to specific risks, and they can share them broadly through reinsurance markets. The cost of insuring against climate-related risks will no doubt rise, but in a market economy those increased insurance costs send powerful economic signals that individuals and corporations will be safer if they avoid exposed locations and prepare for extreme weather.

If these specific risks are addressed and meaningfully disclosed with transparent, auditable, decision-useful metrics, investors will be protected. In our road map we have 53 high-level recommendations, most of which addressed specific risks. As an appendix to this testimony, I have included the chapter of that CFTC report that lists those recommendations.

I am pleased to see that many of those recommendations are being taken up. Since we published that report, the Federal Reserve has joined the international Network for Greening the Financial System. The SEC has started soliciting public comment on regulations for climate risk disclosure by firms. And Randal Quarles, Federal Reserve vice chair and chair of the Financial Stability

<sup>3</sup> Erin Hanan, “[Megafires: Climate change or land management?](#),” Niskanen Center, September 15, 2020.

<sup>4</sup> Paul Voosen, “[Seas are rising faster than ever](#),” *Science*, November 18, 2020.

<sup>5</sup> Stephanie Herring et al., “[Special Report: Explaining Extreme Events of 2019 from a Climate Perspective](#),” *Bulletin of the American Meteorological Society*, 102, no. 1, (January 2021).

Board, recently wrote that the Financial Stability Board is designing a road map for understanding and managing climate risks for the G20 and central bankers.<sup>6</sup>

Unfortunately, these actions are not enough. There are risks that are so extreme that there is no way to diversify the exposure, they are systemic. This is the second kind of risk we need to manage, and it requires a societal response. No entity, for example, can insure society against an equity market crash, nuclear war, or a global pandemic; and similarly, none can insure society against the systemic exposure created by climate change. This risk requires a systematic, coordinated, and comprehensive national and global policy response.

Today, when specific risk protections are inadequate because of the scale of the disaster, we depend on the federal government to provide an emergency backstop. But we cannot simply assume that such a backstop will always be there. We need to act decisively today to ensure that more and more federal bailouts will not overwhelm federal coffers in the case where climate change is unmanageable. If we were to find ourselves in that world, domestic disaster response would not be the only challenge. The indirect effects of climate change — new pandemics, threats to national security from failed states or climate-induced mass emigration<sup>7</sup>, economic retraction in some places — will also demand response. In a world where the effects of climate change are severe, society is likely to start removing CO<sub>2</sub> from the atmosphere by artificial means to restore lower temperatures, at great expense. In that scenario, every ton we release today is a future liability.

To avoid the worst of these systemic threats, we must transform our economy to stop emissions. The scale and urgency of that transformation require that financial markets immediately and dramatically increase the flow of capital toward investments that will reduce emissions. Congress plays a critical role in addressing systemic climate risk. Through fiscal policy, and to a lesser degree direct programs, the federal government directs the flow of capital and supports innovation. The CFTC report is clear: Creating these appropriate incentives “is the single most important step to manage climate risk and drive the appropriate allocation of capital.”

### **Section 3: Responding to Climate Risks**

To reduce our exposure to systemic climate risk, we must start rapidly decreasing our greenhouse gas emissions year-over-year. The longer we wait, the more severe the climate risk will get. To avoid the worst-case scenarios, we should work quickly and effectively to secure absolute emissions reductions. The commonly accepted goal of keeping global warming within 2 degrees centigrade, or as close to 1.5 degrees centigrade as possible, implies that the global economy should operate with net-zero greenhouse gas emissions by the mid-21<sup>st</sup> century.<sup>8</sup>

The United States has made significant progress in reducing its greenhouse gas emissions while maintaining economic growth over the past decade and a half. The U.S. EPA reports that in 2019, gross greenhouse gas emissions were 6577 million metric tons of CO<sub>2</sub>-equivalent (MMT-

<sup>6</sup> Randal Quarles, “[FSB Chair’s letter to the G20 Finance Ministers and Central Bank Governors: April 2021](#),” Financial Stability Board, April 6, 2021.

<sup>7</sup> National Intelligence Council, “[Global Trends 2040: A More Contested World](#),” March 2021: 32-41

<sup>8</sup> UN International Panel on Climate Change, “[Special Report on Global Warming of 1.5C](#),” 2018: Chapter 2

CO<sub>2</sub>eq), down nearly 12 percent from their 2007 peak.<sup>9</sup> That reduction was largely the result of changes in the power sector: switching from coal to natural gas and increasing the share of renewables.

Despite our substantial progress in reducing emissions, if we are to meet midcentury targets, we will have to accelerate emission reductions by two to three times. Last month, President Biden proposed The American Jobs Plan, which would spend billions on climate-related infrastructure, technology innovation, and subsidies for clean energy. Many of those investments will help reduce the costs of low-carbon technology and improve the resiliency of our energy systems.

The level of attention the President, members of Congress on both sides of the aisle, and this committee are devoting to climate change is encouraging. But at the end of the day, the effectiveness of such spending measures, in terms of tons of emissions-reduction per dollar spent, could be many times greater if we created the appropriate incentives for the private sector to fully join the effort. As things stand, there is a bug in the tax code. We allow the risks of climate change to go almost unpriced in market transactions. The best fix for this bug is establishing a price on carbon. I and many other economists can tell you how that price can be determined, but we cannot fix the bug on our own.

#### *Why Carbon Pricing is Important*

It was the first recommendation of the CFTC subcommittee — unanimously agreed to by more than 30 subcommittee members — that the United States should establish a price on carbon:

Recommendation 1: The United States should establish a price on carbon. It must be fair, economy-wide, and effective in reducing emissions consistent with the Paris Agreement. This is the single most important step to manage climate risk and drive the appropriate allocation of capital. — pp 123

As we wrote in the report:

Without an effective price on carbon, financial markets lack the most efficient incentive mechanism to price climate risks. Therefore, all manner of financial instruments — stocks, bonds, futures, bank loans — do not incorporate those risks in their price. Risk that is not quantified is difficult to manage effectively. Instead, it can build up and eventually cause a disorderly adjustment of prices. — pp 4

A carbon price is an essential incentive for a productive net-zero economy, one where gross greenhouse gas emissions are balanced by intentional removal of carbon dioxide from the atmosphere. The call for a price on carbon was recently echoed in the National Academies report *Accelerating Decarbonization of the U.S. Energy System*.<sup>10</sup> The report has a host of recommendations for how the U.S. government can act to reduce greenhouse gas emissions and put the country on an effective path to net-zero, including support for new technologies and

<sup>9</sup> U.S. Environmental Protection Agency, “[Draft Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019](#),” accessed April 2021.

<sup>10</sup> National Academies of Sciences, Engineering, and Medicine, “[Accelerating Decarbonization of the U.S. Energy System](#),” 2021.

environmental management. The authors of that report identified an economy-wide carbon price, set at \$40 per ton and rising at 5 percent per year above inflation, as one of the key policies for “[establishing] U.S. commitment to a rapid, just, equitable, transition to a net-zero economy.”

With a carbon price, the public will get more for its money when making investments. In the presence of a portfolio of policies, even a modest carbon price would contribute to a portfolio of climate policies by reducing the cost per ton of emissions reductions and driving capital into low-carbon investments.<sup>11</sup> It aligns the incentives felt by businesses and individuals with the low-carbon economy. It will amplify investments in low-carbon infrastructure, complement energy efficiency improvements, and supercharge innovation from the research bench to the factory floor. And as a more primary instrument for emissions reductions, a carbon price can be an effective way to reduce emissions with minimal administrative or legal challenges and can put us on a durable path toward ambitious climate targets.

Risk management allows us to integrate the costs of climate change into economic decisions by establishing prices for risks. How should we set that price? Doing so requires applying new models to the problem of climate economics, but illustrates how taking a risk-based approach encourages strong action.

Along with two colleagues, in 2019 I published a new methodology to price climate damages from today’s emissions.<sup>12</sup> We used the same methods that asset managers use to set prices to estimate a price on carbon *that would incorporate risk*. This improves over previous models, like that created by the Nobel-winning economist William Nordhaus. Nordhaus’ work showed us that acting to reduce emissions leads to substantial net benefits, but in his model that reduction could happen slowly and allow for large temperature increases. When we include risk in these models, including a small probability of a worst-case or “catastrophic” scenario, the findings motivate an ambitious and rapid response.

First, we found that the price of climate risks should be much larger than is commonly assumed, and that it should start high and slowly decrease over time. When risk is included, the value of avoiding the worst-case scenarios increases the value of reducing emissions. This is the pricing version of braking hard. Later in my testimony I will highlight some promising carbon pricing proposals that would help us get started.

Second, our results highlight the costs of delay as unpriced risks mount each year. In our model one year of delay in adequately pricing the risks of climate change reduces future consumption by the equivalent of 2 percent. That cost rises rapidly for longer delays, as does the cost of each additional ton of emissions. A decade of delay in adequately pricing climate risk costs the future the equivalent of about \$10 trillion a year, or \$100 trillion for the whole decade. Further delays would cost even more, as mounting risks accelerate the costs of each year of delay.

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<sup>11</sup> Emil Dimanchev and Christopher Knittel, “[Working Paper: Trade-offs in Climate Policy: Combining Low-Carbon Standards with Modest Carbon Pricing](#),” MIT Center for Energy and Environmental Policy Research, November 2020; Brian Prest et al., “[Waiting for Clarity: How a Price on Carbon Can Inspire Investment](#),” Resources for the Future, Report 21-8, April 2021.

<sup>12</sup> Kent Daniel et al., “[Declining CO2 price paths](#),” PNAS, 116, no. 42 (October 2019): 20886-20891

A carbon price would make material improvements to our ability to manage climate risks and living without one is risky business. So how to do it?

*Proposals to Price Carbon*

I would like to briefly pay a tribute to Ted Halstead, an incredibly talented and inspirational leader with the dream of bringing all parties together on this issue. Many of you probably knew Ted and his indefatigable nature. Before his untimely death this past year, Ted was the CEO of the Climate Leadership Council (CLC), which he founded to lead the development of a bipartisan plan to enact a meaningful and durable carbon price in the United States and in major economies around the world.

The CLC, where I serve as board co-chair, has built a large coalition of leading businesses, environmentalists, and luminaries in support of a detailed and actionable proposal to establish a carbon price. The plan that CLC developed and continues to support would allow the U.S. to achieve large emissions reductions while providing direct cash benefits to households in the form of dividend payments, or carbon dividends.<sup>13</sup>

The CLC proposal is built around four pillars: a steadily increasing carbon price, a corresponding household dividend, a border adjustment to enhance the competitiveness of U.S. firms and increase global climate ambition, and a package of regulatory simplification to offer businesses and innovators a more certain investment environment. These pillars work together to create a package that responds to climate risks with the urgency they deserve, provides immediate and visible benefits to American households, allows the best-practices of U.S. manufacturers recognition in markets, and makes industry a partner in climate action. This framework has been endorsed by over 3,500 economists, including four former Fed chairs and 28 Nobel Laureates.

In the CLC plan, the carbon price also starts at \$40 per ton (in 2017 U.S. dollars) in 2023 and increases 5 percent each year over inflation. On its own, such a tax could reduce U.S. greenhouse gas emissions to half of their peak values by 2035, nearly 2,000 MMT CO<sub>2</sub>e from today's levels.

Revenue would be sent back to households in a dividend, ensuring the vast majority of households come out ahead financially, despite the new carbon price. Many believe that a carbon price is regressive, but with a carbon dividend policy the benefits are greatest for middle- and low-income households. In every state, the average household in the lowest seven income deciles is better off with the carbon dividends plan than without it. And those benefits are clear before taking account of the positive benefit to these households of reduced climate risk and local air pollution. Through the COVID-19 pandemic, direct transfers have proven an effective means of improving outcomes for low- and middle-class households. They can do same throughout the transition to a low-carbon economy.

Every corner of the economy would be encouraged to innovate and decarbonize. Economic modeling indicates that the council's plan would unlock \$1.4 trillion of private investment in

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<sup>13</sup> Climate Leadership Council, "[Bipartisan Climate Roadmap](#)," February 2020.

energy innovation and create 1.6 million jobs.<sup>14</sup> A carbon price would accelerate economy-wide electrification, move our electricity grid towards being carbon-free, expand the market for electric vehicles, boost industrial efficiency, secure a future for carbon capture technologies, and make decarbonization itself a competitive advantage.

Adding a border adjustment will give cleaner U.S. firms an advantage over their less efficient competitors, expand the impact of the U.S. climate action footprint, and induce emissions reductions in other countries.<sup>15</sup> The U.S. economy is 80 percent more carbon-efficient than the global average and at least 300 percent more carbon-efficient than major competitors like China, India, and Russia. Adding a carbon price to imports that generate overseas emissions ratchets up ambition for domestic policy and makes the U.S. market a demand-driver of clean goods. There is no other climate policy that simultaneously addresses the emissions footprint of our supply chains, drives manufacturing investment back onto U.S. soil, and forces foreign manufacturers to compete on the basis of carbon efficiency.

It is remarkable that energy companies like BP, ConocoPhillips, Shell, Exxon Mobil, Exelon, Calpine and Vistra; consumer brands like AT&T, Ford and GM, and Procter & Gamble; NGOs like the World Wildlife Fund, the World Resources Institute, and Conservation International; and leaders from both Republican and Democratic administrations like James Baker, George Shultz, Larry Summers and Ernie Moniz have all come together in support of a plan for using market instruments to reduce greenhouse gas emissions. But given the win-win outcomes, it should not be surprising.

*Carbon pricing in the context of the federal budget*

As your committee considers the federal budget, I note that an economy-wide carbon price could raise a significant amount of revenue. The CBO reports that a carbon tax starting at just \$25 per ton could raise just over \$1 trillion in 10 years.<sup>16</sup> The higher carbon price levels imagined by the NAS committee or the CLC could raise approximately \$2 trillion dollars over 10 years. That revenue could be used to reduce the budgetary impact of climate action by investing in infrastructure, budgeting for other tax changes, or sending cash back to households as a dividend as with the CLC proposal. Under any of those scenarios, the tax would motivate private-sector investment in low-carbon technology and innovation. But Congress will need to act to make it happen.

As Congress is considering the President's proposed infrastructure package, there are other proposals that you may want to be aware of. They share many elements with the CLC plan, but differ in broad policy implementations. For example, the Market Choice Act has had bipartisan support in the House of Representatives for the past two Congresses.<sup>17</sup> It is a proposal that would levy a carbon tax to provide funding for infrastructure as a replacement for the federal gas tax. In

<sup>14</sup> Rob West, "Analysis of Climate Leadership Council Proposal," Thunder Said Energy, July 2020.

<sup>15</sup> Catrina Rorke and Greg Bertelsen, "America's Climate Advantage," Climate Leadership Council, September 2020.

<sup>16</sup> Congressional Budget Office, "Options for Reducing the Deficit: 2021 to 2030," December 2020.

<sup>17</sup> Nader Sobhani et al., "The Market Choice Act of 2019," The Niskanen Center, October 13, 2019.

addition to fully funding the highway trust fund, it would provide revenue for broader infrastructure investment, advanced energy R&D, and rebates to lower-income households.

Modeling of that proposal shows that it could reduce energy-related CO<sub>2</sub> emissions by nearly 1900 million metric tons by 2035<sup>18</sup>, while raising about \$1.8 trillion for infrastructure and energy R&D spending. Here too rebates, though smaller than a full dividend, could offset increased prices for low-income workers and retirees. This approach shows that a carbon tax can raise revenue to pay for infrastructure investments while accelerating emissions reductions.

The President has proposed to pay for infrastructure spending with increases in the corporate tax rate and other business taxes. That is a decision that is best left to Congress, but I would note that taxing bad activities, like risking the planetary climate, offers both revenue and social benefit.

Beyond these specific proposals, market-based instruments enjoy substantial support from economists and business leaders. Last year, the Business Roundtable called for “a market-based emissions reduction strategy that includes a price on carbon.” Earlier this year, the U.S. Chamber of Commerce wrote climate policy should “support a Market-Based Approach to Accelerate GHG Emissions Reductions Across the U.S. Economy.” And just weeks before this hearing, the American Petroleum Institute endorsed “a carbon price policy to drive economy-wide, market-based solutions.”<sup>19</sup>

Several members of this committee have introduced carbon pricing legislation in the past or actively support it now. The exact policy construction varies among proposals, but there are other experts who can help Congress understand those policy questions and any resulting tradeoffs. I recognize that there are a variety of opinions about carbon pricing and its design, but leadership and compromise can help build strong coalitions of support.

To manage our climate challenge, the key principles are to create a price immediately, set it high enough to meaningfully reflect the risks imposed by greenhouse gas emissions, and apply it broadly throughout the economy (likely by taxing producers).

### **Conclusion**

Thank you kindly for the invitation to testify today. I hope that this testimony has shown how the tools and insights of financial risk management can be meaningfully applied to the climate problem. When I take this approach, I find compelling reasons to act. We need to take the worst-case scenarios seriously and respond adequately. Because of the nature of climate risks, time is not on our side. There are real costs to waiting. While many of the individual risks from climate change can be managed well by companies, individuals, and governments, the systemic nature of climate risk means we should be doing much more to price it and reduce greenhouse gas emissions.

<sup>18</sup> Marc Hafstead, “[Carbon Pricing Calculator](#),” Resources for the Future, accessed April 2021.

<sup>19</sup> Business Roundtable, “[Market-Based Solutions Best Approach to Combat Climate Change](#),” September 2020; U.S. Chamber of Commerce, “[Our Approach to Climate Change](#),” Accessed April 2021; American Petroleum Institute, “[API Outlines Path for Low-Carbon Future In New Climate Action Framework](#),” March 25, 2021.

I and my colleagues at the Climate Leadership Council, the Niskanen Center, and others stand ready to help you deliberate on these policies and do what is best for Americans and the future. Thank you for your attention and I look forward to answering any inquiries you may have.

Appendix:

CFTC Report of the Climate-Related Market Risk Subcommittee,

"Managing Climate Risk in the U.S. Financial System"

List of Recommendations

# MANAGING CLIMATE RISK IN THE U.S. FINANCIAL SYSTEM

Report of the Climate-Related Market Risk Subcommittee,  
Market Risk Advisory Committee of the  
U.S. Commodity Futures Trading Commission



Commissioner Rostin Behnam, Sponsor

Bob Litterman, Chairman

# List of Recommendations

## Chapter 1

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**Recommendation 1:** The United States should establish a price on carbon. It must be fair, economy-wide, and effective in reducing emissions consistent with the Paris Agreement. This is the single most important step to manage climate risk and drive the appropriate allocation of capital.

## Chapter 4

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Market participants and the regulatory community, in the United States and abroad, are in the early stages of understanding and experimenting with how best to monitor and manage climate risk. Given the considerable complexities and data challenges involved, regulators and market participants should adopt pragmatic approaches that stress continuous monitoring, experimentation, and learning. Regulatory approaches in this area are evolving and should remain open to refinement, especially as the understanding of climate risk continues to advance and new data and tools become available.

At the same time, regulators should establish a clear framework with appropriate milestones. This is what financial regulators are already doing in some jurisdictions and is consistent with recommendations of financial regulatory bodies (Bank of England, 2019; Bank for International Settlements, 2020; NGFS, 2020). As explained above, in general, regulators have sufficient authority to start tackling climate risk immediately. The following recommendations provide, in our view, a good starting point.

### Systemic Risk Oversight

**Recommendation 4.1:** All relevant federal financial regulatory agencies should incorporate climate-related risks into their mandates and develop a strategy for integrating these risks in their work, including into their existing monitoring and oversight functions. Regulators should further develop internal capacity on climate-related risk measurement and management, including through their strategic planning, organizational structure, and additional resourcing.

**Recommendation 4.2:** The Financial Stability Oversight Council (FSOC), of which the Commodity Futures Trading Commission (CFTC) is a voting member, should undertake the following:

- As part of its mandate to monitor and identify emerging threats to financial stability, incorporate climate-related financial risks into its existing oversight function, including its annual reports and other reporting to Congress;

- Encourage and coordinate, across the Council's member agencies, the sharing of best practices concerning the monitoring and management of climate-related risks, the building of relevant institutional capacity, the integration of climate-related risks into the risk monitoring function of the agencies and into financial supervision and regulatory frameworks, and the potential for second-order impacts, such as the migration of financial activity from one part of the financial system to another; and
- Task the Office of Financial Research with developing a long-term program of research on climate-related risks to the financial system, paying close to the potential interconnectivity and spillovers of climate-related risks across the financial system; monitoring relevant developments; and developing tools that regulators can use for the monitoring and management of climate-related risks.

**Recommendation 4.3:** Research arms of federal financial regulators should undertake research on the financial implications of climate-related risks. This research program should cover the potential for and implications of climate-related "sub-systemic" shocks to financial markets and institutions in particular sectors and regions of the United States, including, for example, agricultural and community banks and financial institutions serving low-to-moderate income or marginalized communities. Research should also include the impact of climate risk on financial system assets and liabilities, including by sensitivity of specific sectors to climate change, geographic location, and tenor. In doing so, regulators should identify data gaps and approaches to address these shortcomings. Regulators should develop assessments of the magnitude of the impact of climate on these assets and liabilities, for example through scenario analysis.

**Recommendation 4.4:** Relevant federal regulators should assess the exposure and implications of climate-related risks for the portfolios and balance sheets of the governmentsponsored enterprises (GSEs) and strongly encourage the GSEs to adopt and implement strategies to monitor and manage those risks.

**Recommendation 4.5:** The Federal Insurance Office, in collaboration with state insurance regulators, should undertake an assessment of the insurance sector's systemic vulnerability to climate-related impacts and report the findings to the FSOC. FIO should also evaluate the adequacy of state insurance regulators' oversight of climate-related risks.

**Recommendation 4.6:** Federal financial regulators should actively engage their international counterparts to exchange information and draw lessons on emerging good practice regarding the monitoring and management of climate-related financial risks. U.S. regulators should join, as full members, groups convened for this purpose, including the Central Banks and Supervisors Network for Greening the Financial System (NGFS), the Coalition of Finance Ministers for Climate Action, and the Sustainable Insurance Forum (SIF). The United States should also engage actively to ensure that climate risk is on the agenda of Group of Seven (G7) and Group of Twenty (G20) meetings and bodies, including the Financial Stability Board (FSB) and related committees and working groups. The Federal Reserve already participates in the Basel Committee on Banking Supervision's climate task force, and the

Securities and Exchange Commission participates in the International Organization of Securities Commissions' (IOSCO) sustainable finance network.

### Risk Management

**Recommendation 4.7:** Financial supervisors should require bank and nonbank financial firms to address climate-related financial risks through their existing risk management frameworks in a way that is appropriately governed by corporate management. That includes embedding climate risk monitoring and management into the firms' governance frameworks, including by means of clearly defined oversight responsibilities in the board of directors.

**Recommendation 4.8:** Working closely with financial institutions, regulators should undertake—as well as assist financial institutions to undertake on their own—pilot climate risk stress testing as is being undertaken in other jurisdictions and as recommended by the NGFS. This will enable stakeholders to better understand institutions' exposure to climate-related physical and transition risks, as well as to explore climate-related opportunities. The pilot program should include the testing of balance sheets against a common set of scenarios (elaborated on in Chapter 6 and Recommendation 6.6), covering how financial institutions might respond to climate-related risks and opportunities over specified time horizons. This climate risk stress testing pilot program should include institutions such as agricultural, community banks, and non-systemically important regional banks.

**Recommendation 4.9:** Regulators should closely monitor international experience with climate risk stress testing of banks and insurers and apply relevant lessons to the U.S. context. U.S. regulators should engage in international forums, such as the NGFS, to ensure that climate risk stress testing conducted in the United States is comparable to similar exercises in other jurisdictions and avoid duplicative exercises for institutions with a multi-jurisdictional footprint.

**Recommendation 4.10:** Financial authorities should consider integrating climate risk into their balance sheet management and asset purchases, particularly relating to corporate and municipal debt.

**Recommendation 4.11:** The CFTC should:

- ⊗ Undertake a program of research aimed at understanding how climate-related risks are impacting and could impact markets and market participants under CFTC oversight, including central counterparties, futures commission merchants, and speculative traders and funds; the research program should also cover how the CFTC's capabilities and supervisory role may need to adapt to fulfill its mandate in light of climate change and identify relevant gaps in the CFTC's regulatory and supervisory framework;
- \* Drawing on the conclusions of the research program above, review the extent to which existing CFTC rules are adequate to monitor and manage climate-related risks. For example, CFTC should review the extent to which rules for non-centrally cleared over-the-counter derivatives (NCD) are appropriate for monitoring and managing climate-related risks. It should also review rules related to capital and margin requirements of futures commission merchants and swap dealers, as well as initial

margin and default fund rules, risk management rules, and capital requirements pertaining to central counterparties;

- Expand its own central counterparty stress testing to cover the operational continuity and organizational resilience of central counterparties, including organizational resilience of operations, contingency planning, and engineering resilience for facilities exposed to climate-related physical risks. Where central counterparties and market infrastructure are not within the CFTC's direct supervisory remit, the supervision of physical risks should be addressed by the relevant FSOC member in a consistent fashion; and • As better understanding emerges of the risk-transmission pathways and of where the material climate risks lie, consider expanding the CFTC's risk management rules and related quarterly risk exposure reports to cover material climate-related risks.

**Recommendation 4.12:** State insurance regulators and insurance regulators' supervisory colleges, which are convened by regulators where an insurer or its subsidiaries or affiliates operate in multiple jurisdictions, should:

- Require insurers to assess how their underwriting activity and investment portfolios may be impacted by climate-related risks and, based on that assessment, require them to address and disclose these risks; and
- To facilitate the risk assessment mentioned in the point above, insurance regulators should conduct, or require insurance companies to conduct, climate risk stress tests and scenario analyses to evaluate potential financial exposure to both the physical and transition impacts of climate change; state insurance regulators should provide the scenarios, assumptions, and parameters for the stress testing exercise.

**Recommendation 4.13:** Regulators should require insurers to integrate consideration of climate risks into insurers' Enterprise Risk Management (ERM) and Own Risk Solvency Assessments (ORSA) processes.

**Recommendation 4.14:** Regulators should require credit rating agencies to disclose the extent to which their ratings take into account climate risk, including for issuers of corporate, municipal, and sovereign debt. This should include a disclosure of applicable methodologies for those credit rating products that consider climate risk.

#### Financial Market Utilities

**Recommendation 4.15:** Federal regulators should ensure that risk management standards governing the operations related to the payment, clearing, and settlement activities of FMUs incorporate measures to monitor and manage physical climate risks. The CFTC, in its capacity as an FSOC member, should recommend that the Council oversee and coordinate this process as it pertains to FMUs designated as systemically important.

**Recommendation 4.16:** The CFTC should review the extent to which financial market infrastructure—including but not limited to systemically important FMUs for which it is the primary regulator—is resilient against losses that could arise through the physical impacts of climate change.

## Chapter 5

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**Recommendation 5.1:** Financial regulators, in coordination with the private sector, should support the availability of consistent, comparable, and reliable climate risk data and analysis to advance the effective measurement and management of climate risk.

- ✦ Regulators and financial institutions should support the range of platforms for climate data and analysis, including improving public access to governmental data and expertise that can enable climate risk management. They should also support new and existing open source platforms, as well as proprietary efforts to develop new climate risk datasets and tools that leverage innovative technologies.

**Recommendation 5.2:** Financial regulators, in coordination with the private sector, should support the development of U.S.-appropriate standardized and consistent classification systems or taxonomies for physical and transition risks, exposure, sensitivity, vulnerability, adaptation, and resilience, spanning asset classes and sectors, in order to define core terms supporting the comparison of climate risk data and associated financial products and services.

- ✦ To develop this guidance, the United States should study the establishment of a Standards Developing Organization (SDO) composed of public and private sector members.
- ✦ Recognizing that this guidance will be specific to the United States, this effort should include international engagement in order to ensure coordination across global definitions to the extent practicable.

**Recommendation 5.3:** Financial regulators should proactively encourage capacity building for climate risk management. This should be consistent with the education and training practices supported by agencies in implementing the Sarbanes-Oxley Act of 2002. It should align with and aid in meeting regulator expectations around embedding climate risk in governance frameworks.

## Chapter 6

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### Scenarios and Scenario Analysis

Climate scenario analysis should focus on potential material impacts to the institution's financial portfolio, whether loans, derivatives, or investments. In this context, the following guidelines should be useful:

**Recommendation 6.1:** Analyze more than one warming path. Various long-term paths for climate change exist and can be used for scenario analysis. Three common scenarios are (i) Paris-aligned (for example, consistent with limiting temperatures well below 2 degrees Celsius above pre-industrial levels), (ii) current trajectory and (iii) in-between (for example, late policy adoption with a more abrupt and disruptive response). Each will produce different impacts on institutional portfolios and provide insights that will help to more effectively manage risk, particularly bookends of best- and worst-case scenarios. Scenarios should include both shorter- and longer-horizon paths as appropriate.

**Recommendation 6.2:** Analyze disruptive policy. It is particularly important to analyze a scenario involving a major policy disruption. Transition scenarios have wide implications across the economy, industries, and markets. Unanticipated policies can abruptly strand long-lived capital assets or induce rapid reallocation of capital across sectors and industries. Increasing physical impacts may increase the risks of a disorderly transition as fires, floods, and hurricanes, and the attendant shifts in public sentiment, force governments into unanticipated policy responses. Scenarios are therefore especially relevant for risk management.

**Recommendation 6.3:** Analyze both broad and specific impacts. Scenarios should capture the breadth of impacts but with a focus on materiality, covering a global perspective but enabling regional, country, and sectoral analysis appropriate to the firm's business.

**Recommendation 6.4:** Map macroeconomic and financial impacts. Scenarios should take into account macroeconomic and financial outcomes since these are likely to be most material to financial institutions. Coming up with additional temperature scenarios, for example, is less important than providing some common guidance on potential transmission mechanisms and implications for macroeconomic and financial factors.

**Recommendation 6.5:** Account for adaptation actions to the extent feasible. Tackling climate change necessarily involves myriad adjustments by a range of actors. Modeling the effects of such adaptation actions on portfolios is complex but may become more feasible with future technology and scenario modeling development.

### Policymakers and Regulators

**Recommendation 6.6:** Prescribe a consistent and common set of broad climate risk scenarios, guidelines, and assumptions and mandate assessment against these scenarios, as described in Chapter 4. Regulators, in consultation with industry participants, external experts, and other stakeholders, should develop and prescribe a consistent set of broadly applicable scenarios, guidelines, and assumptions and require institutions to assess their exposure to those scenarios. Climate scenarios should be both plausible and relevant, all the while informed by climate science. Regulators should require a range of climate scenarios, including scenarios covering severe but plausible outcomes. Key assumptions (including policy pathways) and limitations should be transparent. Scenarios, assumptions,

and guidelines should be updated as relevant factors are better understood and as policy and technology evolve. There should be a recognition that climate risk will manifest differently across various parts of the financial system.

**Recommendation 6.7:** Provide analytical discretion, to the extent practicable, as long as regulatory needs for consistency and comparability are met. Given the many unknowns and complexities inherent in modeling the economy, climate change science, and policy, regulated entities will need some discretion in how they perform their analysis based on the prescribed scenario. On the other hand, regulators need consistent approaches across firms so they can ensure risks are responsibly analyzed and reported. Investors would benefit from better comparability across scenario-related disclosures. To achieve a balance across these needs, regulators, in consultation with the firms they regulate, should specify key assumptions, scope, and the outputs they expect. As long as regulators' prescribed expectations are satisfied, regulators should allow financial institutions to provide additional context and analysis informed by the nature and complexity of their business.

**Recommendation 6.8:** Encourage domestic and global coordination across regulators to provide a coherent approach. This is an overarching theme of this report and especially applicable to the use of scenarios for risk management. Requiring entirely different stress scenario exercises from institutions operating under different jurisdictions would be costly while generating uncertain value. Harmonizing requirements and prioritizing practical, actionable exercises where feasible would be useful. The high costs associated with multiple regulatory regimes is a lesson of post-financial crisis regulation that can be applied now to climate risk.

**Recommendation 6.9:** Focus on materiality and risk management. Climate risks can manifest in many different ways. Institutions should focus on what matters for them and what decisions need to be made given their specific exposures and vulnerabilities. Such an approach facilitates effective risk management by laying out plausible ways climate risk-related financial losses could occur.

**Recommendation 6.10:** Ensure a mechanism for ongoing refinement and improvement. As science, data, tools, conditions, and policy change, it is important for regulatory guidelines to evolve as well. Data in particular is evolving rapidly. Creating a mechanism for regular updating, rather than relying on ad hoc adjustments, would be beneficial to ensure effective and pragmatic oversight. As regulators better understand the material risks in the system and their spillover effects across industries and markets, a mechanism for ongoing learning and timely refinement from these lessons learned will ensure they are most effectively managing risk across the system.

### Capabilities and Applications

Given the uncertain nature of how the climate will evolve and the limited ability to rely on historical data and back-testing, robust scenario analysis calls for a new set of capabilities that combines statistical, financial, and environmental knowledge.

**Recommendation 6.11:** Tailor analysis to specific exposures. How an institution analyzes scenarios should be determined based on the unique nature of its portfolio. Not every scenario will be material to an institution's portfolio, depending on its largest asset concentrations, longest-dated assets, and highest potential sensitivities.

**Recommendation 6.12:** Use results to upgrade risk management capabilities. Regulators and risk managers can use insights coming from scenario analyses to strengthen and augment existing institutional risk management. Each institution should determine how to do so within its own framework but could include climate-related limits, adjustment to underwriting processes, client engagement, and climate risk appetite.

**Recommendation 6.13:** Beware of false precision. Scenario analysis can provide great value in understanding a range of potential outcomes (particularly between worst and best cases) and in identifying concentrations and relative sensitivities in a portfolio. But results, especially quantitative ones, will be illustrative, not precise, and so should be used accordingly in risk management decisions.

#### Risk Managers

**Recommendation 6.14:** Risk managers should develop in-house capabilities, as relevant and in line with best practices, to analyze climate scenarios, understand the key underlying assumptions, and recognize the limitations.

**Recommendation 6.15:** Firms and institutions should consider additional climate scenarios, guidelines and assumptions tailored to their specific needs and vulnerabilities, in addition to those provided by policymakers and regulators, to enhance internal risk management and decision-making. This can focus on generating decision-useful information for identifying and managing climate risk given their specific exposures and vulnerabilities.

**Recommendation 6.16:** The scope, depth, and complexity of the analyses performed by institutions should be proportionate to the materiality of the impact measured.

## Chapter 7

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In developing and implementing the recommendations below, financial regulators and the entities they oversee should consult with stakeholders, including investors, businesses, global peers, and other market intermediaries to create a U.S. climate disclosure regime. They also should closely coordinate with international bodies and foreign regulators to ensure the U.S. regime is aligned internationally. Because the understanding of climate risk remains at an early stage, any regulatory approach to climate-related disclosure should evolve in line with emerging best practices. Regulators should continually monitor the state of corporate climate disclosures, evolving clarity on the financial impacts of climate change and emerging best practices. This will allow regulators to continually monitor the quality of the information disclosed in a sophisticated manner, and issue supplemental guidance or begin rulemaking where needed to reflect emerging best practice and market needs. A mandatory, standardized disclosure framework for material climate risks, including guidance about what should be disclosed that is closely aligned with developing international consensus, would improve the utility and cost-effectiveness of disclosures.

### Financial Market Regulators

**Recommendation 7.1:** All financial regulators should consider the following principles for effective disclosure, which are mainly derived from principles developed by the Task Force on Climate-related Financial Disclosures, when developing rules on climate risk disclosure, implementing existing rules or guidance, or seeking public comment on actions they should take:

- ✦ Disclosures should represent relevant information.
- ✦ Disclosures should be specific and complete.
- ✦ Disclosures should be clear, balanced, and understandable.
- ✦ Disclosures should be consistent over time.
- ✦ Disclosures should be comparable among companies within a sector, industry, or portfolio.
- ✦ Disclosures should be reliable, verifiable, and objective.
- ✦ Disclosures should be based on current consensus science (and updated as the science evolves) and the best available projections regarding climate change impacts.
- ✦ Disclosures should be provided on a timely basis.

**Recommendation 7.2:** Material climate risks must be disclosed under existing law, and climate risk disclosure should cover material risks for various time horizons. To address investor concerns around ambiguity on when climate change rises to the threshold of materiality, financial regulators should clarify the definition of materiality for disclosing medium- and long-term climate risks, including through quantitative and qualitative factors, as appropriate. Financial filings should include disclosure of any material financial risks from climate change in a consistent but non-boilerplate manner, as well as a qualitative description of how firms assess and monitor for potential changes in climate risks that may become material.

**Recommendation 7.3:** Regulators should consider additional, appropriate avenues for firms to disclose other substantive climate risks that do not pass the materiality threshold over various time horizons outside of their filings. Regulators should consider that a growing number of companies are creating greenhouse gas reduction targets and strategies out to the year 2035 or 2050, and targeted disclosure related to these items may be appropriate to facilitate robust efforts toward this positive trend.

**Recommendation 7.4:** Recognizing the costs associated with collecting, assessing and disclosing climate risk information, financial regulators should consider whether smaller companies could be provided a longer period of time to provide their initial disclosures, and the specific disclosures required of those companies could be different and less burdensome than those required of larger issuers.

**Recommendation 7.5:** In light of global advancements in the past 10 years in understanding and disclosing climate risks, regulators should review and update the SEC's 2010 Guidance on climate risk disclosure to achieve greater consistency in disclosure to help inform the market. Regulators should

also consider rulemaking, where relevant, and ensure implementation of the Guidance. Such an update could incorporate advice on:

- ④ Information that is needed from all companies in order to enable financial regulators to assess the systemic risks posed by climate change. Federal financial market regulators should work closely with prudential regulators to develop these rules.
- ④ Industry-specific climate risk information. Rules should build from existing standards that provide industry-specific climate disclosure recommendations, for example, those developed by the TCFD, SASB, CDSB, the Physical Risks of Climate Change (P-ROCC) framework, and the Global Real Estate Sustainability Benchmark (GRESB) standards for real estate and infrastructure. Because these standards are already sophisticated, regulators do not need to create their own standards or metrics from scratch. Regulators should encourage stakeholders to partner with these standardsetting bodies to further develop, standardize, implement, and validate these metrics over time. Regulators should also acknowledge, in any rulemaking, that climate disclosure standards continue to evolve, and it could provide issuers flexibility, where appropriate, to adopt these evolving standards.
- ④ Governance, risk management and scenario planning information that demonstrates how well companies are situated for a clean energy transition. Federal financial market regulators should work closely with prudential regulators to develop these rules. Scenario planning disclosure is discussed in Chapter 6. Regarding governance and risk management disclosure, regulators should consider the TCFD's recommendations and the Committee of Sponsoring Organizations of the Treadway Commission/World Business Council for Sustainable Development (COSO/WBCSD) guidance, applying enterprise risk management to environmental, social and governance-related risks.

**Recommendation 7.6:** Regulators should require listed companies to disclose Scope 1 and 2 emissions. As reliable transition risk metrics and consistent methodologies for Scope 3 emissions are developed, financial regulators should require their disclosure, to the extent they are material.

**Recommendation 7.7:** Regarding derivatives, financial regulators should examine the extent to which climate impacts are addressed in disclosures required of the entities they regulate and consider guidance and rulemaking if disclosure improvements are needed. This could include, for example, swap dealers registered with the CFTC, risk management rules that govern risk identification approaches; Quarterly Risk Exposure Reports, and business conduct rules that govern disclosure of material information to counterparties prior to entering into a swap.

#### Accounting Standards Regulators

**Recommendation 7.8:** Once climate risk disclosure standards are well advanced, accounting standards regulators should undertake a mapping exercise of the applicability of accounting standards to climate-related disclosure and subsequently issue guidance on disclosure, as appropriate. This would provide U.S. companies greater clarity about how climate risks may be integrated into financial statements.

**Recommendation 7.9:** The United States should direct the Federal Accounting Standards Advisory Board (FASAB) to study and pilot the development of climate-related federal accounting standards, disclosure procedures and practices for U.S. government departments, agencies and administrative units.

#### Municipal Securities Regulators

**Recommendation 7.10:** Municipal securities regulators should provide improved tools on the EMMA website to search for climate-related disclosure in municipal bond filings, similar to that provided for publicly traded companies, to allow better assessments of potential climate risk exposure in such assets and how they are being addressed.

**Recommendation 7.11:** Municipal securities regulators and the federal financial market regulator overseeing them should examine the quality of climate-related disclosures in municipal bonds' official statements and continuing disclosures, and whether the disclosure provided is adequate for market participants to assess any underlying climate risk exposure. If disclosure is found to be deficient, they should issue a public statement calling on key stakeholders to improve disclosure, including municipalities, municipal advisers, and banks.

**Recommendation 7.12:** Municipal securities regulators and federal financial market and prudential regulators should study how risks facing municipalities differ from—and could in some cases be more impactful than—risks facing issuers and explore options to enhance disclosure on these issues. Some municipalities already disclose information, as part of their bond issuances, about floods, storms, dam safety, droughts, wildfires, sea level rise, and risk mitigation efforts, and further study could demonstrate that such disclosure should be enhanced.

## Chapter 8

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Effective and well-functioning markets should allocate capital efficiently to net-zero emissions investments, spur innovation, and create and preserve quality jobs in a growing net-zero economy. These recommendations seek to meet these goals by improving the functioning of markets by reducing structural barriers and catalyzing private sector innovation. In undertaking these efforts, consideration should be paid to the distributional and equity impacts on low-to-moderate income households and marginalized communities. In addition, efforts should aim to facilitate an orderly transition, where possible, avoiding adding financial strain on already stressed sectors, including agricultural producers and commercial and industrial companies, among others.

**Recommendation 8.1:** The United States should consider integration of climate risk into fiscal policy, particularly for economic stimulus activities covering infrastructure, disaster relief, or other federal rebuilding. Current and ongoing fiscal policy decisions have implications for climate risk across the financial system.

**Recommendation 8.2:** The United States should consolidate and expand government efforts, including loan authorities and co-investment programs, that are focused on addressing market failures by

catalyzing private sector climate-related investment. This effort could centralize existing clean energy and climate resilience loan authorities and co-investment programs into a coordinated federal umbrella.

**Recommendation 8.3:** Financial regulators should establish climate finance labs or regulatory sandboxes to enhance the development of innovative climate risk tools as well as financial products and services that directly integrate climate risk into new or existing instruments.

**Recommendation 8.4:** The United States and financial regulators should review relevant laws, regulations and codes and provide any necessary clarity to confirm the appropriateness of making investment decisions using climate-related factors in retirement and pension plans covered by the Employee Retirement Income Security Act (ERISA), as well as non-ERISA managed situations where there is fiduciary duty. This should clarify that climate-related factors—as well as ESG factors that impact risk-return more broadly—may be considered to the same extent as “traditional” financial factors, without creating additional burdens.

**Recommendation 8.5:** The CFTC should pursue the following activities to further catalyze climate finance market development:

- Survey market participants about their use of climate-related derivatives, the adequacy of product availability and market infrastructure, and the availability of data to incorporate climate impacts into existing and new instruments.
- Consider appropriate and targeted exemptions where needed to help facilitate coordination with other regulators and promote market development.
- Support the study and adoption of alternative execution methods, such as block trading, auction style markets, or incentive programs, to attract liquidity providers to make climate-related markets.
- Coordinate with other regulators to support the development of a robust ecosystem of climate-related risk management products.





PREPARED STATEMENT OF MR. STIGLITZ

Testimony of Joseph E. Stiglitz

Before the U.S. Senate Committee on the Budget

“The Cost of Inaction on Climate Change”

April 15, 2021

Thank you for this opportunity to share with you some of my concerns about the large economic costs and huge risks of not taking strong actions now to deal with climate change, and the large benefits of doing so.

Some of the downside risks are already apparent. In one recent year, the magnitude of destruction associated with extreme weather events—which will inevitably occur more frequently, with ever more devastation as a result of climate change—was more than 1.5% of GDP, effectively wiping out more than 60% of the growth of that year.<sup>1</sup> But this is only one dimension of what is occurring: Rising sea level will put much coastal property under water, destroying homes and property values. Forward-looking markets have already begun to price this in—but still far from adequately.<sup>2 3</sup>

Recent studies have documented the adverse effects of climate change on health.<sup>4</sup> We pay for this in multiple ways, including higher health care costs and a less healthy population, which means a less productive workforce. But there is no way to accurately monetize the shorter life spans and the increased morbidity.

Of course, there are actions we can take that can offset some of these adverse effects, but it will take effort and resources. It would be far better to devote these efforts and resources to

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<sup>1</sup> <https://www.climate.gov/news-features/blogs/beyond-data/2018s-billion-dollar-disasters-context>

<sup>2</sup> <https://anderson-review.ucla.edu/is-the-1-trillion-coastal-housing-market-a-future-financial-crisis/>; [http://real-faculty.wharton.upenn.edu/benkeys/wp-content/uploads/-benkeys/Research\\_files/Keys\\_Mulder\\_SLR\\_Exec\\_Summary.pdf](http://real-faculty.wharton.upenn.edu/benkeys/wp-content/uploads/-benkeys/Research_files/Keys_Mulder_SLR_Exec_Summary.pdf)

<sup>3</sup> It's almost nowhere to be found in current home prices, mortgage insurance rates, or guarantee fees in the secondary mortgage market (<https://www.nytimes.com/2019/09/27/climate/mortgage-climate-risk.html>). The implications are discussed below.

<sup>4</sup> [https://health2016.globalchange.gov/low/ClimateHealth2016\\_FullReport\\_small.pdf](https://health2016.globalchange.gov/low/ClimateHealth2016_FullReport_small.pdf);

increasing living standards rather than adopting defensive measures. As the old adage put it, an ounce of prevention is worth a pound of cure.

There are, of course, some sectors, some parts of our population, some locations that will be particularly hard hit. During the past year, we have seen the inequities associated with Covid-19. Those associated with climate change are equally severe, with people at the bottom of the income ladder often bearing the brunt of the costs, with fewer resources to respond. But there is an additional dimension of inequity that speaks to our future: While Covid-19 disproportionately affected older Americans, climate change is a risk that we impose on our children and grandchildren—on the future of our country. It is understandable why younger Americans, including those not yet of voting age, have been among the most vocal about climate change.<sup>5</sup> Many in this Congress have worried about the magnitude of the financial debt that we are bequeathing to future generations. But when there are high return assets to match that debt—investments in R&D, in infrastructure, in education—we bequeath them a stronger country. If we were talking about a company, we would highlight the increased net worth. The same reasoning should apply to a country. But if we leave them a world marked by environmental degradation and resource depletion—a world in which they will have to confront climate change and its consequences—we are truly bequeathing them a debt, a real deficit, which risks substantially lowering their standards of living.

### ***Risks***

Let me spend a few moments discussing the real risks our economy and society face if we do not take stronger actions than we have so far. We have been treating truly scarce resources, our environment, our water, our air, as if they were free. But economics teaches us that there is no such thing as a free lunch. We will have to pay the check someday. And delay is costly. Taking carbon out of the atmosphere is far more expensive than not putting it into the atmosphere. A smooth transition is far less costly than the one we will surely face if we do not take action urgently.

In 2008 we saw the financial destruction that came about as a result of the sudden readjustment in the pricing of one part of our housing market. The failure there would have brought down our

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<sup>5</sup> Including taking legal action. See the so-called Children's suit, [\*Juliana vs. the US\*](#)

financial system if governments had not acted forcefully. A full accounting of the costs to our societies over the succeeding years suggests that they were in the trillions of dollars. There will be a repricing of carbon assets. This I firmly believe. Carbon assets, such as those associated with coal and oil companies, do not today adequately reflect the realities of climate change. The longer we delay dealing with climate change, the larger the necessary adjustments will be, and the greater the potential for huge economic disruption—an economic disruption that could make the 2008 Great Recession look like child’s play by comparison.<sup>6</sup> The danger of a crash is particularly acute for the U.S. economy, given that large U.S. banks are the largest financiers of fossil fuel.<sup>7</sup>

The insurance industry is heavily exposed, too. Over time, I would expect that they will be more careful in providing coverage—and that means more Americans will have to manage these risks on their own. And ultimately, we know what that means: When large calamities occur, as seems inevitable, the government will pick up the bill. This is a huge hidden liability on the government’s balance sheet.

### *Opportunities*

Economics has, for good reason, been called the dismal science. The scenario of doom and gloom that I have painted is, unfortunately, all too real. But I want to end on a sunnier note. Doing something about climate change could be a real boon for the economy.

Too often, critics of taking action point to the job losses. Change is costly. But change provides opportunity. I am also firmly convinced that the opportunities afforded by addressing climate change are enormous. The number of jobs that will be lost in the old fossil fuel industries are dwarfed by those that will be created in the new industries. The value created in the new industries will also dwarf the value of the stranded assets in the fossil fuel and related sectors. As just two examples: the number of installers of solar panels already is a multiple of the number of coal miners; the auto company with the highest valuation today is Tesla.

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<sup>6</sup> For a discussion of the systemic risks associated just with the property market noted above, see <https://greatdemocracyinitiative.org/wp-content/uploads/2020/07/Climate-and-Housing-Report-Final-Copy.pdf>.

<sup>7</sup> <http://priceofoil.org/2021/03/24/banking-on-climate-chaos-2021/>

The current focus on changing to a green economy is already stimulating enormous innovation, innovation that holds out the promise of significant increases in standards of living. The price of renewable energy has been plummeting, and in many areas outcompetes fossil fuels. The drive for a greener society is stimulating the design of new buildings and new ways of doing agriculture, which turn out actually to save resources, particularly if we value them appropriately.

Our country especially has much to gain, because innovation is a key comparative advantage. If we are ahead of the game—rather than a laggard—we will develop technology that will be in demand around the world. If we are behind the game, we will pay a high price. It is almost inevitable that other countries will demand cross-border adjustments that will put our companies at a disadvantage.

Government has an important role in enabling, facilitating, and encouraging the transition to a green economy. One might say we are in good luck: The deficiencies in public investment over the past decades has made it imperative that we undertake such investments now; and we can make those investments “green” investments. The investments themselves will create an enormous number of jobs, stimulating the economy and banishing to the past discussions of secular stagnation that have abounded for the past two decades. They will also crowd-in private investment. Basic research and technology investments by government, for instance, provide the foundations for investments by the private sector. We saw that in the case of the internet; we saw that in the case of the vaccines that were produced with such rapidity in response to Covid-19. And we will see it with these green investments as well.

#### ***More To Be Done***

There is much more to be done to protect the economy from the risks I have described.<sup>8</sup> For instance, we need immediately to end fossil fuel subsidies and require full disclosure of climate risks—both the risks of physical damage and the financial risks. Markets on their own don’t provide adequate disclosure, necessary both for the efficient allocation of scarce capital and for protecting investors. We need to change statutes governing fiduciary responsibility to mandate

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<sup>8</sup> See, for instance, J. E. Stiglitz, “Addressing Climate Change Through Price and Non-Price Interventions,” *European Economic Review*, Vol. 119, pp. 594-612, October 2019. Accessible at: <https://www.sciencedirect.com/science/article/pii/S001429211930090X?dgcid=author>

looking at these long-run risks, and especially where government is at risk, as in government insurance pension schemes. When the government is providing insurance or finance—whether it's through FDIC or through Fannie Mae—we as taxpayers need to be apprised of all these risks; or more pointedly, we shouldn't be taking on these risks. We shouldn't be insuring banks that make loans that put our planet at risk. We also know that when all is said and done, the government will pick up the pieces when there is systemic financial fragility—and that's why it's imperative that we start assessing, and regulating, systemic climate risk.

We have long been aware that in certain key areas there may be deficiencies in the provision of adequate finance. Economists have explained why that's the case, and governments around the world have stepped into the breach. There is, I believe, the need for the founding of a national infrastructure bank and for seeding the creation of community, state, and regional banks to facilitate green investments. We should never again allow the deficiency in infrastructure, which I referred to earlier, to be built up.

### *Social Cost of Carbon*

Within the economy, within companies, and within government, prices help guide decisions. That's why assigning a near-zero price to resources that are scarce is such a bad mistake, and leads to such bad outcomes. We need to be aware of the social cost of carbon. Unfortunately, the interim social cost of carbon that was arrived at was much, much too low. If used as a basis for guiding the economy, it would result in temperature increases of 3.5 to 4 degrees C.—temperatures we have not seen in millions of years, with untold risks that the international community has rightly shied away from.<sup>9</sup> We need to employ a significantly high social cost of carbon, accompanied by regulations, and public investments that will enable us to deal with risks that have rightly been called existential.<sup>10</sup>

<sup>9</sup><https://www.jse.ac.uk/granthaminstitute/news/economists-warn-against-biden-administration-underestimating-the-social-cost-of-carbon/>

And N. Stern and J. E. Stiglitz, THE SOCIAL COST OF CARBON, RISK, DISTRIBUTION, MARKET FAILURES: AN ALTERNATIVE APPROACH Nicholas Stern Joseph E. Stiglitz Working Paper 28472, January, 2020 ([https://www.nber.org/system/files/working\\_papers/w28472/w28472.pdf](https://www.nber.org/system/files/working_papers/w28472/w28472.pdf))

<sup>10</sup> See Nicholas Stern, J. E. Stiglitz and Commission Members "Report of the High-Level Commission on Carbon Prices," Carbon Pricing Leadership Coalition, International Bank for Reconstruction and Development and

*Concluding Remarks*

This is a defining moment in history. On the one hand, we can ignore these risks, at great peril to our future. On the other hand, we can seize this opportunity and move away from an energy and economic system that has dominated the world for two centuries. What we have accomplished in the last twenty years should provide us with the confidence that this new economy can provide a new era of innovation, creating more and better jobs and a higher standard of living. This new era will play to America's strengths, to the determination and ingenuity of people and the vitality of its institutions—including those that have long fostered innovation.

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International Development Association/ The World Bank, May 29,2017 accessible at <https://www.carbonpricingleadership.org/report-of-the-highlevel-commission-on-carbon-prices/>

PREPARED STATEMENT OF MR. OLIVER

PREPARED STATEMENT OF GEORGE OLIVER  
CHAIRMAN AND CHIEF EXECUTIVE OFFICER, JOHNSON CONTROLS  
CHAIR, BUSINESS ROUNDTABLE ENERGY AND ENVIRONMENT COMMITTEE

“CLIMATE CHANGE: THE COST OF INACTION”  
Before the  
U.S. SENATE COMMITTEE ON THE BUDGET  
April 15, 2021

Chairman Sanders, Ranking Member Graham and Members of the Committee, I am George Oliver, Chairman and Chief Executive Officer of Johnson Controls International. I also have the privilege of chairing the Energy and Environment Committee of Business Roundtable. I am appearing today on behalf of both Johnson Controls and Business Roundtable. Thank you for holding this important hearing to examine the costs associated with failure to address climate change and for the invitation to appear before you.

Founded in 1885, Johnson Controls is a global leader in smart, healthy and sustainable buildings technology solutions. The company has a global team of 100,000 employees, with deep industry knowledge and expertise and serves more than four million customers in 150 countries around the world. Our core building systems portfolio includes heating, ventilation and air conditioning (HVAC), Building Automation & Controls, Fire, Security, and Industrial Refrigeration and our connected technologies and digital capabilities help our customers optimize their facilities performance, enhance occupant experiences and meeting their own energy efficiency and sustainability goals.

Business Roundtable is an association of chief executive officers of America’s leading companies working to promote a thriving U.S. economy and expand opportunity for all Americans through sound public policy.

Business Roundtable exclusively represents chief executive officers (CEOs) of America’s leading companies. These CEO members lead companies with 20 million employees and more than \$9 trillion in annual revenues. As major employers in every state, Business Roundtable CEOs take seriously the responsibility of creating quality jobs with good wages. These leaders join with communities, workers and policymakers to build a better future for the nation and its people.

Climate Change is Real and Must be Addressed

In 2007, Business Roundtable became the first broad-based business organization to recognize the threat posed by climate change and to acknowledge the need to address it. As its 2007 Climate Statement noted “[b]ecause the consequences of global warming for society and ecosystems are potentially serious and far-reaching, steps to address the risks of such warming are prudent even now, while the science continues to evolve.” The science has evolved over the past 14 years and it has become even clearer the world must address the causes of climate change if we are to avoid its worst effects.

In September of last year, Business Roundtable adopted an updated climate statement which acknowledged there is a scientific consensus that the climate is changing and human activities are contributing to that change. The statement emphasized that “[u]nchecked, the changing climate poses significant environmental, economic, public health and security threats to countries around the world, including the United States. The risk of unanticipated changes and impacts -- some of which may be large and irreversible -- will only increase as the Earth’s system warms more quickly.”

The statement also stressed that “[t]he consequences of climate change for global prosperity and socioeconomic well-being are significant; the world simply cannot afford the costs of inaction.”<sup>1</sup>

At Johnson Controls, sustainability is our business. We have been reporting our emissions and taking action to reduce our footprint for 20 years. We were among the first industrial companies to join the UN Global Compact and through an aggressive series of enterprise-wide initiatives, we have cut our energy intensity by more than 50% and our greenhouse gas intensity by more than 70%. Our efforts have been recognized by many third-party organizations, and we are proud to be AAA MSCI rated, included in more than 40 sustainability indices, and named to the World’s Most Ethical Companies Honoree List and one of the 100 Best Corporate Citizens. In January 2021, we announced ambitious new sustainability commitments that outline our priority to make positive changes in reducing our company’s environmental footprint. Building on our history of sustainability leadership, we committed to achieving net zero carbon emissions before 2040 and announced science-based targets for 2030. We set a goal to double our customers’ emission reductions through implementation of our OpenBlue digitally enabled solutions.

#### The Costs of Inaction

While costs associated with failure to address climate change may be difficult to quantify precisely, we know these costs exist and failure to address global climate change could mean trillions of dollars in lost U.S. GDP over the coming decades. The adverse economic impacts of a “business as usual” emissions trajectory would be felt across the entire economy, from the labor market, to healthcare, productivity, business investment, infrastructure, and real estate. Economic models only scratch the surface when it comes to forecasting the costs of climate change as they cannot fully capture the impact of uncertainty on economic activity, human health, productivity, quality of life, agriculture, and business investment, particularly decades into the future. Despite the limitations of existing models, economic and climate research shows that “business as usual” emissions pathways could severely impact U.S. economic growth over the coming decades. Under the UN’s Intergovernmental Panel on Climate Change “unmitigated emissions growth” scenarios, the U.S. could face a significant GDP penalty over the next several decades, on the order of a 10.5% per capita decline by 2100.<sup>2</sup>

In a technical analysis done for the Fourth National Climate Assessment, a multi-U.S. agency report mandated by Congress, EPA, assuming business-as-usual emissions, estimated that by 2050, major natural disasters will increase in frequency and cause an estimated \$112 billion per

<sup>1</sup> Business Roundtable, *Addressing Climate Change: Principles and Policies* (2020). ([Link](#))

<sup>2</sup> Kahn, M. et al (2019). *Long-term Macroeconomic Effects of Climate Change: A Cross-Country Analysis*. NBER Working Paper. ([Link](#))

year in damages; and extreme temperature mortality will lead to an additional 3.4 thousand deaths annually with \$43 billion in lost wages per year.<sup>3</sup> Another study concluded coastal property will face increased risk as real estate valued between \$66 billion and \$106 billion falls below sea level.<sup>4</sup> Yet another study estimates *annual* direct U.S. losses for extreme weather events and wildfires could double by 2090 to \$156 billion.<sup>5</sup>

It is clear the risks associated with unchecked climate change are real; the risks are increasing; they are likely to be costly; and some changes could be irreversible. Other risks, such as those associated with national security, are not easily captured by economic models but they are just as real and must be taken into consideration.

#### The U.S. Must Lead by Example

The world still has time, although very little time, to avoid the “business-as-usual” scenarios used in most of the economic models I have cited. In order to avoid the worst impacts of climate change, the world must work together to limit global temperature increases. The United States and the international community must aggressively reduce greenhouse gas (GHG) emissions and create incentives for developing new technologies to achieve these reductions. Johnson Controls and Business Roundtable support a comprehensive policy to reduce GHG emissions.

Core principles to guide this comprehensive public policy should include the following:

- Align policy goals and GHG emissions reduction targets with scientific evidence.
- Increase global engagement, cooperation and accountability.
- Leverage market-based solutions wherever possible.
- Provide for adequate transition time and long-term regulatory certainty.
- Preserve the competitiveness of U.S. businesses, including avoiding economic and emissions “leakage”.
- Minimize social and economic costs for those least able to bear them.
- Support both public and private investment in low-carbon and GHG emissions reduction technologies along the full innovation pipeline.
- Minimize administrative burdens and duplicative policies while maximizing compliance flexibility.
- Ensure that U.S. policies account for international emissions reductions programs.
- Advance climate resilience and adaptation.
- Eliminate barriers to the deployment of emissions reduction technologies and low-carbon energy sources.

<sup>3</sup> EPA (2017). *Technical Report for Quantitative Sectoral Impact Analysis: A Technical Report for the Fourth National Climate Assessment*. ([Link](#))

<sup>4</sup> Houser, T. et al. (2015). *Economic Risks of Climate Change; An American Prospectus*. Columbia Univ. Press. ([Link](#))

<sup>5</sup> RMI (2020). *Our Climate as an Infrastructure Asset*. ([Link](#)) (Damage estimates derived from Fourth National Climate Assessment (2017))

Both business and government must lead by example to address this challenge. A growing number of U.S. and global companies have adopted GHG emissions pledges, many of which commit to “net-zero” GHG emissions by 2050.

Let me address some of the key policies that will be necessary to meet the scope of the climate challenge.

#### Drive Energy Efficiency

First, the United States should continue to cost-effectively and reliably reduce emissions by improving the efficiency of energy production, distribution and use – even as we continue to invest in new innovations and technologies. Sustained advances in energy efficiency technologies, in combination with wider deployment of those technologies across the transportation, buildings, industrial and commercial sectors, have resulted in flattening energy demand in the United States since the mid-2000s, even as economic activity picked up after the 2008-09 recession.<sup>6</sup> While it is too soon to be certain what energy demand will be following full economic recovery from the COVID-19 pandemic, there is every reason to believe the efficiency trends in place before the pandemic will continue once a full recovery is in place. Sound public policy—including especially legislation encouraging public private partnerships, strong model building codes, and energy savings contracts can help accelerate these trends.

Since 40% of global CO<sub>2</sub> emissions are from the building sector and three quarters of those emissions are attributable to building operations, Johnson Controls is always looking at better ways we can help our customers optimize building performance and achieve deep sustainability outcomes. This extends to the way we support our customers in the Federal Government.

For example, we are embarking on a partnership with the U.S. General Services Administration (GSA), to significantly upgrade several historic buildings in the National Capital Region including the Ronald Reagan Building and International Trade Center, the New Executive Office Building, the Eisenhower Executive Office Building, the Jackson Place complex, the Winder Building, and the Civil Service Building.

These facility improvements will be implemented under an Energy Savings Performance Contract (ESPC) that will result in guaranteed savings of about \$6.2 million per year in energy and water and reduce greenhouse gases by 20,000 tons per year - the equivalent of removing 4,500 cars from the road. Leveraging Johnson Controls’ comprehensive suite of building solutions, upgrades will include HVAC, lighting, water conservation, and energy management systems. Moreover, we will deploy Johnson Controls’ “OpenBlue” digital capabilities to enable such significant efficiency improvement to be achieved and to future-proof these historic buildings—positioning them to be smart, connected, and sustainable.

Our company’s sustainability commitments also advance national security and diplomatic objectives. For example, U.S. Army Garrison Kwajalein Atoll (USAG-KA) is home to the

<sup>6</sup> U.S. Energy Information Administration (2021, March) Monthly energy review, Consumption by sector; Table 2.1 <https://www.eia.gov/totalenergy/data/monthly/>.

Ronald Reagan Ballistic Missile Defense Test Site (RTS). The RTS, which supports ballistic missile defense systems and space operations, is crucial to the national defense strategy. The installation is very remote, located 2,100 miles from Hawaii in the Republic of the Marshall Islands. At present, all power is generated onsite by diesel-fueled power plants; no offsite utility providers exist—posing a threat to facility operations. That is about to change: as part of a three-phased ESPC partnership with the Army, Johnson Controls will design and build resilient energy solutions, including island-wide photovoltaic distributed generation and battery storage controlled by a cyber-secure microgrid. The project reduces dependence on diesel fuel by 55% and delivers 8 tons of greenhouse gas emission reductions.

Currently, the Army is reviewing a proposed Phase II ESPC project from Johnson Controls that would utilize sea water to help provide cooling for the main island of Kwajalein. The ability to utilize sea water would also provide the installation with a resource to produce their own potable water through a reverse osmosis plant. The project would reduce energy requirements of the Island by 29% and achieve another 25 tons of greenhouse gas emission reductions, while saving the Army \$13M in the first year of operation [can we add an expected lifetime savings number?]. We look forward to approval of the next phase of this project to further assist the Army in achieving their strategic goals.

Johnson Controls is also leading similar sustainability efforts for our customers in the education, housing, state and local government, corrections, healthcare and commercial sectors.

For example, Mr. Chairman, in your home state of Vermont, Johnson Controls partnered with Rutland City Public Schools over the past decade to implement three enormously successful energy saving performance contracts. These projects have allowed for the repair and modernization of school facilities and cut the carbon footprint of the buildings, while substantially reducing the need for capital funding because the upgrades are being paid for with energy savings. In fact, the District realized a 31 percent energy reduction during fiscal year 2020 from the combination of the Phase 1 and Phase 2 projects as compared to 2008 energy usage. Phase 3 is lowering the District's electrical usage by an additional 44 percent.

Senator Graham, in your home state, Johnson Controls completed a similar project for the City of Charleston in which we reduced energy and water use throughout their 3.67 million square feet of building space and 1,806 acres of parks. Through lighting and building control system upgrades, building envelope improvements, and HVAC replacement, we saved the city over \$15 million, provided over \$17 million in infrastructure renewal and reduced CO<sub>2</sub>e emissions by over 45,250 metric tons.

These energy savings performance contracts are one of many creative ways in which the private sector can partner with government to maximize climate-friendly infrastructure improvements, while decreasing the burden on the taxpayer. We encourage Congress to support these efforts wherever possible.

### Invest in Technology

Even fully maximizing energy efficiency opportunities and deploying existing emissions reduction technologies will not be sufficient to achieve the ambitious goal of net-zero emissions by 2050 that many companies have adopted. In many cases, achieving these targets will require new technologies to move through the innovation pipeline to reach commercial viability. In some cases, such as the building sector in which Johnson Controls operates, there is a clear pathway to achieving significant carbon reductions in a cost-effective way in the near future. Other sectors, however, such as the steel, chemical and cement industries, will find it extremely difficult to achieve meaningful carbon reductions without new breakthrough technologies becoming technically and economically viable.

Achieving the emissions reductions needed in these and other sectors means investing now in solutions needed over the long-term. Energy innovation is characterized by high capital-intensity, high risk and potentially lengthy payback periods. These conditions create a clear need for public investment and support, which Congress has the opportunity to provide. We were encouraged to see that the President's American Jobs Plan called for a significant increase in research and development funding devoted to clean energy and other associated enabling technologies, and we look forward to working with Congress and the Administration on this important issue. We support at least doubling federal funding from current levels for advanced energy innovation and further support doubling total climate-related research funding, including funding for adaptation, resiliency and mitigation research.<sup>7</sup> In addition to stepping up funding, RD&D programs must be better coordinated across economic sectors and focused on technologies that are most likely to reduce GHG emissions on a life-cycle basis and to achieve global cost-parity with high-emissions competitors.

### Place a Price on Carbon

A market-based emissions reduction strategy that includes a price on carbon where it is environmentally and economically effective and administratively feasible provides an effective incentive to reduce GHG emissions and mitigate climate change, including through the development and deployment of breakthrough technologies. Paired with robust, targeted public support for research and development, and smart, non-duplicative regulations, establishing a clear price signal is an impactful approach for encouraging innovation in the new technologies needed to reach ambitious mid-century climate goals, driving efficiency, and ensuring sustained environmental and economic effectiveness. Properly constructed, a price on carbon can also

<sup>7</sup> Business Roundtable was informed by work done by the American Energy Innovation Council. (2015, February). Restoring American Energy Innovation Leadership: Report Card, Challenges, and Opportunities, available at: [AEIC-Restoring-American-Energy-Innovation-Leadership-2015.pdf](#). See also: [Energy-Innovation-Fueling-Americas-Economic-Engine.pdf \(americanenergyinnovation.org\)](#). A doubling would result in a budget slightly over \$16 billion per year for clean energy research. A December 2020 report by the Energy Innovation Council called for tripling clean energy R&D to \$25 billion per year for deep decarbonization: <http://americanenergyinnovation.org/2020/12/energy-innovation-developing-the-technologies-for-decarbonization/>. For recommendations regarding better coordination see GAO, *Analysis of Reported Federal Funding: A Report to the Chairman, Committee on Science, Space and Technology*. House of Representatives (2018) available at: <https://www.gao.gov/assets/gao-18-223.pdf>

preserve the competitiveness of U.S. businesses and support policies that spur economic growth and provide assistance for those individuals and communities most negatively affected.

#### Conclusion

It is clear the risks and potential costs associated with unchecked climate change are real and some of these risks pose changes that may be irreversible. While existing economic models are inadequate to capture the range of potential costs, it is reasonable to assume these costs will be in the trillions of dollars to the U.S. economy over the decades to come. In order to avoid the worst impacts of climate change, the world must work together to limit global temperature increases. The United States and the international community must aggressively reduce GHG emissions and create incentives for developing new technologies to achieve these reductions. At Johnson Controls we know that when we take this challenge on, we will cut emissions, cut costs, create good jobs and more resilient, healthy infrastructure.

Thank you again for the opportunity to appear here today. I would be happy to answer any questions you might have.

PREPARED STATEMENT OF MR. POWELL

**Testimony of Richard J. Powell  
Executive Director, ClearPath Inc.  
Senate Committee on The Budget  
The Cost of Inaction on Climate Change  
Thursday, April 15, 2021**

Good morning Chairman Sanders, Ranking Member Graham and Members of the Committee. My name is Rich Powell, and I am the Executive Director of ClearPath.

ClearPath is a 501(c)(3) organization whose mission is to develop and advance policies that accelerate breakthrough innovations that reduce emissions in the energy and industrial sectors. We develop cutting-edge policy solutions on clean energy and industrial innovation, and we collaborate with public and private sector stakeholders on innovations in nuclear energy, carbon capture, hydropower, natural gas, geothermal, energy storage, and heavy industry to enable private-sector deployment of critical technologies. An important note: we receive zero funding from industry.

Given this committee's vital role in America's fiscally responsible approach to the global climate challenge and the economic recovery challenges ahead, I will discuss five key topics today:

- The threat to the U.S. economy and our federal budget posed by climate change, and how its global nature requires a reorientation of politically realistic policy towards an innovation-focused approach.
- The need to invest in targeted solutions by setting aggressive bipartisan goals, versus endlessly spending more federal dollars given our national budget constraints.
- The opportunity for investments in clean energy, like implementing the Energy Act of 2020, to produce tangible clean energy and global competitiveness benefits for Americans.
- The reality that we can only build new clean energy projects and reduce carbon dioxide emissions as fast as we can permit new projects – if we are to truly build back better, our mission ought to be 'build cleaner faster.'
- The priority to build on the historic, strong bipartisan support for clean energy innovation – a one-party approach to energy policy has never and will not stand the test of time.

**An Innovation-Focused Approach to Global Climate Change**

Climate change is real, industrial activity around the globe is the dominant contributor to it, and the challenge it poses to society merits significant action at every level of government and the private sector.

Lawmakers and businesses across the country are prioritizing investments in climate change adaptation efforts. The Florida state legislature, led by large Republican majorities, just last

week advanced a bill to Governor DeSantis' desk which would require a master plan for the state to deal with sea level rise and flooding, and established a fund providing up to \$100 million annually for climate resiliency projects.<sup>1</sup> Meanwhile, Louisiana has a \$50 billion coastal master plan for coastal restoration in part due to rising sea levels<sup>2</sup>.

Managing our country's debt will be another defining challenge of this century. As millions of Americans are handing over thousands of dollars of their hard-earned income on tax day, they are also wondering how it is possible that our national debt recently surpassed \$28 trillion.

Since 1980, the United States has spent \$1.9 trillion in Disaster Recovery from 290 "billion-dollar events."<sup>3</sup> From 2014 to 2018, the United States has seen an annual average of 13 billion-dollar disasters. This has all been deficit spending. If we don't better prepare – both with smarter investments in adaptation and by mitigating the underlying problem with global clean energy solutions – we will massively deepen deficit spending. According to the Federal Emergency Management Agency, every \$1 spent on pre-disaster mitigation saves on average \$6.<sup>4</sup>

Some of America's largest publicly owned utilities and major American companies are also taking action against climate change to reduce emissions. The Business Roundtable has been leading on clean energy innovation policy solutions to reduce its members' carbon emissions. Microsoft Corp, PepsiCo, and General Motors are among some of the largest American-based, multinational corporations that have made ambitious net-zero commitments in recent years. America's largest electric utilities, including Southern Company, Xcel Energy, Duke Energy, and DTE have also committed to reaching net-zero emissions by 2050. According to the Smart Electric Power Alliance, 68 percent of all electricity customer accounts in the country are now served by a utility with a significant carbon emissions reduction goal, and 19 of the 48 companies setting goals are for net-zero or carbon-free power by 2050.

Xcel Energy, whose territory extends across some of the windiest and sunniest regions of the country, has one of the most ambitious climate goals in the industry – 80 percent clean by 2030 and 100 percent clean by 2050. They have said that even with their first rate access to wind and sun, existing technology today is sufficient to reach only 80 percent clean, but not 100 percent clean.

As the Committee considers the budgetary demands of each of these challenges and the President's "skinny budget" proposal, it is important U.S. policy synchronizes with the global nature of the climate challenge. Reducing American emissions is essential, and we have seen a significant decline already. Since U.S. emissions peaked in 2005, power sector emissions have fallen by over 33 percent, largely due to the abundance of cleaner natural gas, coal to gas

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<sup>1</sup> <https://abcnews.go.com/Politics/wireStory/legislation-fight-sea-level-rise-florida-governor-76954829>

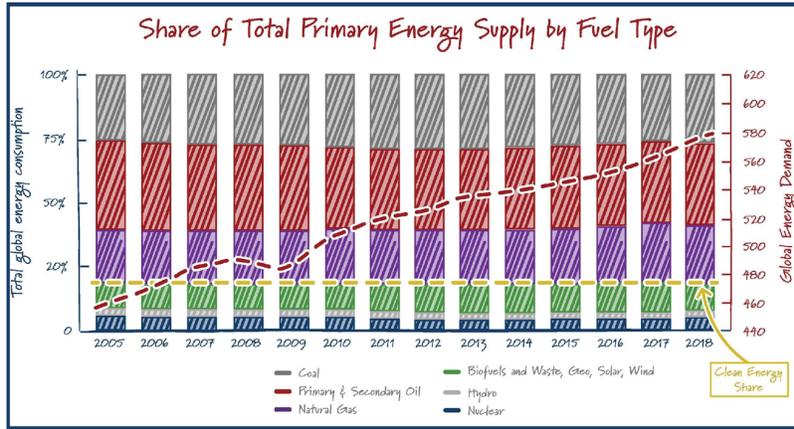
<sup>2</sup> <https://coastal.la.gov/our-plan/>

<sup>3</sup> <https://www.ncdc.noaa.gov/billions/>

<sup>4</sup> <https://fas.org/sqp/crs/homesec/IN11187.pdf>

power switching, as well as an increase in renewables.<sup>5</sup> But, even if the U.S. somehow eliminated all of our carbon emissions tomorrow, just the growth in carbon emissions from today through 2050 by developing Asian countries (e.g., China, India) would exceed total U.S. emissions today.<sup>6</sup>

However, clean technology available today is simply not up to the task of global economy-wide decarbonization. As the chart below indicates, the global supply of clean energy has remained stagnant since 2005. We need to focus on breakthrough technologies that can truly begin to make a dent in the problem.



Sources: IEA World electricity generation mix by fuel, 2020; BP Statistical Review, 2020

**Investing Versus Spending**

Before I started at ClearPath, I was a business consultant at McKinsey & Company. Of all the business philosophy I read and used to help clients, the simplest and most important came from the great Stephen Covey. His second rule for success was elegant, and all important: Begin with the end in mind.

When we confront the problem of a changing climate in a rapidly developing world, the end we must begin with is this: rapidly developing countries choosing to buy and build clean energy technologies over carbon-intensive, traditional energy technologies. If that choice is difficult,

<sup>5</sup> Emissions data sourced from Rhodium Group Climate Deck. <https://climatedeck.rhg.com/>  
<sup>6</sup> Energy Information Administration. *International Energy Outlook, 2019 Table: World carbon dioxide emissions by region.* <https://www.eia.gov/outlooks/aeo/data/browser/#/?id=10-IEO2019&region=0-0&cases=Reference&start=2010&end=2050&f=A&linechart=Reference-d080819.3-10-IEO2019~Reference-d080819.16-10-IEO2019&ctype=linechart&sourcekey=0>

they will choose it infrequently. Today, unmitigated Chinese coal plants are cheaper, easier to build, and better performing as *an energy system* than clean technologies. Some countries might pay a premium for clean development. Others will not. At ClearPath, we would argue that our “end” ought to be making that technology choice easy for developing countries – to make clean energy systems cheaper, better performing, and easier to buy and build than carbon-intensive energy systems.

With that end in mind, we need to evaluate our tools. We cannot spend our way to a solution – the global energy economy and the demands of rising populations around the world are too much even for the mighty U.S. budget to facilitate these decisions around the world. The U.S. also cannot regulate or tax our way to a global solution. Domestic-only approaches may seem well-intentioned, but the U.S. has no magical mechanism to simultaneously regulate other countries’ emissions.

Rather, we need to invest in a set of better mousetraps. You may know the saying, “build a better mousetrap and the world will beat a path to your door.” Ones that will leverage the scarce dollars of U.S. taxpayers into solutions that the global economy will pick up on their own merits, not because we are controlling their domestic policy. This kind of investment is the very definition of a market-based solution to climate change, one that makes markets themselves the force for change in distributing clean energy, instead of the force we work against.

In the U.S., our clean energy budget policy debate is often caught between two extreme perspectives. On one side, some prefer a laissez-faire capitalist approach with a very limited scope of federal dollars used in the electricity sector, regardless of whether that approach is sufficient to reduce the risks of climate change. On the other, some argue for a Green New Deal, and a government-controlled power sector, regardless of whether that approach will produce globally relevant clean tech breakthroughs.

To the first point — many people ask why shouldn’t energy companies be the ones to invest in research and bring new energy technology to market, aka Silicon Valley innovation? Unfortunately, advanced nuclear technology isn’t Uber and can’t be created by two people in their garage, and the clean energy benefits won’t immediately be rewarded. Energy innovation requires massive scale, sometimes taking decades to get from lab to market. And even then, the market is not as simple as going to a store and buying your new favorite gadget off the shelf – the power industry is a highly regulated commodity market that is structurally discouraged from bringing new technologies to market due to the way utilities are regulated or wholesale power markets are structured.

Given these dynamics, new energy technologies would not and have not happened without investments from the U.S. Department of Energy (DOE). Two of the most important breakthrough clean energy technologies that have been responsible for carbon emissions reductions have been hydraulic fracturing and solar. Both followed the same pathway to success. Early government R&D targeted outcomes, and were built alongside partnerships with private industry and tax credits to facilitate commercialization. To best leverage taxpayer dollars,

this government support, while useful, should expire as technology matures and becomes commercially viable.

Energy research is a multi-billion-dollar opportunity to find the next hydraulic fracturing-like technology breakthrough. But without federal support, even a superior energy technology – a truly better mousetrap – won't be able to break into the market because the incumbent technologies have the scale and supporting infrastructure of a 50-year head start.

To the second point, on permanently funding a few already commercialized technologies such as wind or solar — America's clean energy policy needs a technology-inclusive approach. If the recent Texas blackouts taught us anything, we need a diverse portfolio of resilient clean energy technologies to maintain system reliability and affordability. Supercharging innovation and financing first-of-a-kind projects, such as the carbon capture projects in Nebraska, Louisiana or North Dakota, or the X-energy small modular reactor in Washington, are real-world answers to a clean, reliable energy future. Some upcoming energy breakthroughs already have received important help from the DOE. Others still need much more to get to scale. Then, the new technology can succeed or fail on its own merits on a level playing field.

That's the governmental role we need, and it's neither a command-and-control approach that defines market outcomes, nor a do-nothing-and-hope-for-a-miracle approach. The potential returns of such investment are world-changing.

#### **Investment Goals Need Clear Outcomes**

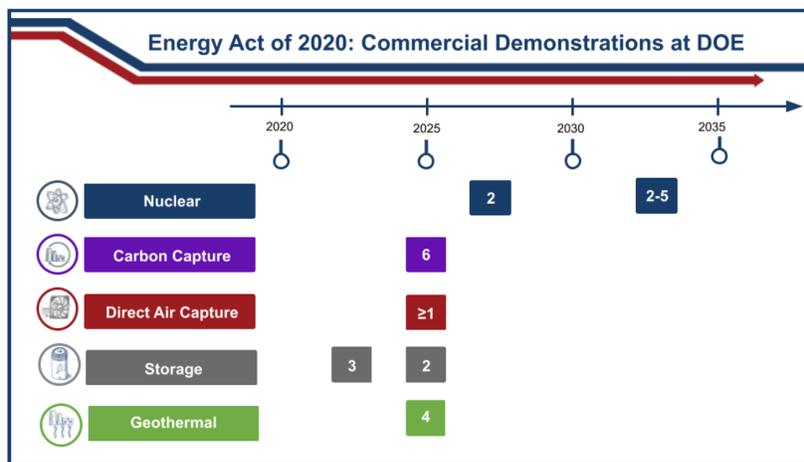
To reduce global emissions as quickly and cheaply as possible, better, cost-effective clean technology is necessary so the developing world will consistently choose those tools over the higher-emitting options they are choosing today. And our Department of Energy and national lab system – the leading technology incubator of the world that has catalyzed such life-altering creations such as nuclear power, LED light bulbs, and sequencing the human genome – can bring forth those breakthroughs. With the U.S. as the world's innovation center, chances remain high that the new generation of miracle technologies will be created in an American laboratory in collaboration with the U.S. private sector. These low-cost, high-performing technologies will be the backbone of efforts particularly targeting rising carbon emissions in the developing world.

The exciting news? At the end of 2020, Congress passed one of the biggest advancements in clean energy and climate policy we've seen in over a decade with the monumental Energy Act of 2020, which was part of the bipartisan omnibus appropriations law and COVID relief package.

The bipartisan law refocuses the DOE's research and development (R&D) programs on the most pressing challenges — scaling up flexible, 24/7 clean energy technologies. Refocusing and modernizing key research, development, and demonstration (RD&D) programs is essential to securing our nation's role as a global technology innovation leader while facilitating a cleaner, more reliable, and affordable domestic electricity supply for the American public.

Specifically, it launches initiatives to support:

- The Advanced Reactor Demonstration Program, to demonstrate two new nuclear designs in the next six years, and another wave of two to five designs by the mid-2030s;
- Six carbon capture demonstrations (at least two for coal, two for natural gas, and two for industrial) by 2025;
- An Air Capture Technology Prize Competition for at least one project by 2025 to advance commercial direct air capture and storage technologies;
- Three demonstrations of innovative new storage technologies by 2023 and two more by 2025 as part of the DOE-U.S. Department of Defense joint long-duration storage initiative; and
- Four enhanced geothermal projects in diverse geographic areas by 2025.



The moonshot technology RD&D investment goals in the Energy Act of 2020 will provide enhanced flexibility to the electric grid, including deploying demand response and energy storage technologies at scale.

As we begin with the end in mind, let me share a few examples of what an outcome looks like with the support of smart investment – in other words, why simply more spending and subsidies will not catalyze the innovation we need.

DOE has been most successful when it has set long-term, aggressive milestones to develop and stand-up new technologies at price points and performance levels that are meaningful for private markets. Its legacy work on unlocking shale gas, the Energy Efficiency and Renewable Energy Office's work on SunShot to radically decrease the cost of photovoltaic solar, and the Joint Bioenergy Initiative on lignocellulosic biofuels at the Lawrence Berkeley Laboratory are all

strong examples. When DOE has clear, well understood and shared goals, combined with strong innovative leadership, clear organizational accountability owning results, and steady investments against that goal over multiple administrations, the Administration tends to produce breakthrough results.

Another technology with great potential: energy storage. We believe energy storage technologies have the potential to modernize and harden the U.S. electricity system, and ultra-cheap renewables with long duration storage will be major contributors to low-cost, high-performing clean energy systems. Across the country, utilities are deploying lithium-ion batteries to meet short-term, several hour storage potential, but that technology has limitations. The future grid will need a suite of different storage technologies that have not yet been commercialized. This is why the DOE's RD&D programs are so important.

Currently, energy storage R&D at DOE lacks the organizational accountability needed for breakthrough success. The programs are spread across DOE in four offices from Electricity to EERE to Science to the Advanced Research Project Agency-Energy (ARPA-E). Many of these offices historically were primarily focused on transportation rather than grid-scale storage. The Fiscal Year (FY) 2020 budget took a major step in the right direction by proposing a "launchpad" hosted at the Pacific Northwest National Lab (PNNL) focused on developing, testing and evaluating battery (and potentially other) materials and systems for grid applications.

In January 2020, DOE launched the Energy Storage Grand Challenge (ESGC), a comprehensive program to accelerate the development, commercialization, and utilization of next-generation energy storage technologies and sustain American global leadership in energy storage. DOE invests about \$400 million per year in energy storage-related RD&D, yet the Department has never had a complex-wide energy storage strategy — until now. This framework was cemented into law with passage of the Better Energy Storage Technology (BEST) Act as part of the Energy Act of 2020. We're heading in the right direction with this crucial technology.

Perhaps nothing has illustrated the smart investment strategy more than the shale gas revolution. It took bold and visionary R&D, tax incentives and other federal help to lead to what has unquestionably been an economic windfall that will continue for many decades, and has been the primary emissions reducer for the U.S.

But this all started in 1977 when the Department of Energy demonstrated hydraulic fracturing in shale. DOE invested \$500 million in applied R&D with the private sector — in particular, a long-term, public-private partnership with Mitchell Energy to demonstrate the technologies. And then between 1980-2002, the government offered \$10 billion in tax incentives. The Gas Research Institute contributed another \$100 million of voluntary commitments from the private sector. This concentrated applied R&D and public private partnership unlocked a remarkable, market-driven transition in the U.S. power sector such that gas is now the largest source of electricity generation. We have significantly decreased U.S. power emissions *and* electricity

system costs, and now have become virtually energy independent, radically rebalancing global energy diplomacy.<sup>7</sup>

When goal-oriented energy R&D is smartly invested for the country, it pays back exponentially. The shale gas revolution contributes an estimated \$100 billion to consumers every year, and has been the main driver behind reducing power sector emissions in the past decade. And thankfully, we are applying a similar R&D and tax incentive formula that we used for shale gas now toward advanced nuclear, carbon capture and, to a growing extent, energy storage.

### **Build Cleaner Faster**

As we reimagine our energy grid using exciting new technologies, permitting modernizations must keep pace with the transition to a clean energy economy. The transition will require tens of thousands of miles of new pipelines carrying hydrogen and captured carbon dioxide from power plants and industrial facilities, new transmission infrastructure to carry electricity around an increasingly electrified country, and new power plants sited everywhere.<sup>8</sup> This will be the largest continental construction project in history, and every one of those projects will begin with a permit.

Making the permitting process more efficient is essential for two reasons: one, stewardship of taxpayer resources, and two, scaling clean energy rapidly. Streamlining and accelerating project permitting should focus on the following four steps:

1. Prioritize the review of clean energy projects. Additional resources should be provided to speed up the National Environmental Policy Act (NEPA) review process for projects that significantly reduce emissions.
2. Expedite review timelines to ensure a decision is made. The permitting process needs to be shortened so clean energy developers get to a yes — or importantly, a no — faster. Clean energy can only be deployed as quickly as these permits can be issued.
3. Reduce the amount of bureaucracy and red tape. Remove obstacles to reduce the burden of the permitting process, and we should consider expanding the use of shorter processes for clean technology.
4. Ensure all communities benefit from clean energy projects. These projects can have a positive impact on surrounding communities by creating good-paying jobs, addressing environmental pollution problems, and making clean energy more accessible and more affordable.

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<sup>7</sup> <https://clearpath.org/energy-101/hydraulic-fracturing-a-public-private-rd-success-story/>

<sup>8</sup> E. Larson, C. Greig, J. Jenkins, E. Mayfield, A. Pascale, C. Zhang, J. Drossman, R. Williams, S. Pacala, R. Socolow, E.J Baik, R. Birdsey, R. Duke, R. Jones, B. Haley, E. Leslie, K. Paustian, and A. Swan, Net-Zero America: Potential Pathways, Infrastructure, and Impacts, interim report, Princeton University, Princeton, NJ, December 15, 2020. [https://netzeroamerica.princeton.edu/img/Princeton\\_NZA\\_Interim\\_Report\\_15\\_Dec\\_2020\\_FINAL.pdf](https://netzeroamerica.princeton.edu/img/Princeton_NZA_Interim_Report_15_Dec_2020_FINAL.pdf)

At ClearPath, we believe all of this can be done by improving the process without changing any of the environmental protection laws. Let's remember that streamlining NEPA, or the administration of NEPA, changes nothing requiring a project to comply with the Clean Air Act, the Clean Water Act, the Endangered Species Act, or other pillars of our nation's environmental protection policy. And, we believe such reform can be done without introducing more regulation or new taxation, or revoking the public's opportunity to be involved in the review process.

**Strong Bipartisan Clean Energy Investment Record**

Finally, how can we build on recent bipartisan support for all these exciting opportunities for more clean energy innovation? In addition to the bipartisan authorizations in the Energy Act of 2020, the most recent FY20 & 21 appropriations bills are great successes, and I applaud the critical programmatic direction and eagle-eyed investments in advanced nuclear, carbon capture, grid-scale storage and other clean energy technologies included.

In fact, from FY14 through FY21, Congress significantly increased federal funding for clean energy R&D on breakthrough technologies in a number of applied offices – 268 percent for energy storage, 70 percent for nuclear energy, 52 percent for ARPA-E, and 33 percent for carbon capture and fossil energy.

While these investments are impressive, your strategy to make this less about the money and more about clear objectives in the programs is even more important. Money should follow those clear objectives and demonstrations through public-private partnerships, which is an essential step towards fulfilling our goal of America providing affordable clean energy technology to the rest of the world. In the cases where you have set moonshot goals and driven applied R&D, there are multiple instances that have led to front-end engineering design studies and in some cases – actual demonstrations are underway.

Program	Progress toward moonshot demonstration			Funding increase since FY14
	Applied research	FEED* studies	Demonstrations underway	
Energy Storage	✓	✓	✓	268%
Nuclear	✓	✓	✓	70%
Carbon Capture	✓	✓		33%
Geothermal	✓		✓	131%
ARPA-E	✓		✓	52%

\*FEED stands for Front-End Engineering Design

With these efforts and the Energy Act of 2020, Congress sent an undeniable message that lawmakers are serious about keeping the U.S. in the top tier of countries pursuing clean and reliable energy breakthroughs. While steady and sufficient funding is essential, providing important direction and reforms to the DOE to make sure that dollars are well spent is equally as vital to spurring clean energy innovation.

Making investments in these programs will greatly impact the acceleration of clean energy innovation, and we are very much looking forward to continuing that wonderful momentum.

Again, we must think globally when approaching this challenge. Partisan, economy-wide spending efforts will not pass the political sustainability test needed for climate solutions. Likewise, halting pipelines or placing moratoriums on oil and gas drilling on federal lands also has little to no impact on actual carbon dioxide emissions in the U.S., let alone the rest of the world. We agree, the cost of inaction on climate is high, and finding bipartisan common ground on clean energy innovation policy is priceless.

Thank you again for the opportunity to provide remarks. ClearPath is eager to assist the Committee in developing innovative policies, identifying opportunities for investments instead of spending, tracking successful outcomes around the new moonshot energy technology goals outlined above, and building cleaner faster. We applaud the Committee for taking on this important task to help ensure the appropriate investments can be made to modernize and facilitate the research, development, and demonstration of cutting-edge energy technologies in the service of a stable global climate.

## Responses To Written Questions of Senator Murray From David Wallace-Wells

**Question: Mr. Wallace-Wells, in your book *The Uninhabitable Earth*, you include a section titled *Unbreathable Air*. In this section you write about the impacts dust exposure, ozone smog, and small-particulate pollution from wildfires and burning of fossil fuels can have on health. Can you expand on the health impacts climate change will have on the US population, and specifically for children?**

Answer: The effects from air pollution are, I think, most significant and most important—in part because they are underappreciated; in part because the effects from wildfire are likely to grow dramatically over the next few decades in the American West and in your home state of Washington; and in part because they represent, I think, a very useful communications tool that illustrates that the risks of climate change, in addition to being global, are also local, and that the benefits of decarbonization can be felt by every individual citizen, breathing cleaner air.

As I noted in my testimony, 350,000 Americans are dying every year, according to one recent estimate, from air pollution produced from the burning of fossil fuels. And here is just a partial list of the things and conditions, short of death, we know are affected by air pollution:

GDP, with a 10% increase in pollution reducing output by almost a full percentage point in a given year. Cognitive performance, with studies showing, for instance, that simply reducing Chinese pollution to the standards set by the American EPA would improve the country's verbal test scores by 13 percent and its math scores by 8 percent. And in Los Angeles, when \$700 air purifiers were installed in schools in a panicked response to an ultimately nonthreatening local gas leak, student performance improved as much as it would if the class sizes were reduced by a third. In the United States, the charter and school reform movements have spent a generation trying to achieve these kinds of gains, out of nationalistic anxiety that the school systems of rival nations might achieve them first.

Heart disease is more common in polluted air, as is cancer of countless varieties, acute and chronic respiratory diseases like asthma, and strokes. The incidence of Alzheimer's can triple. Dementia rates grow, too, as do those of Parkinson's. Air pollution has been linked to mental illness of all kinds, and to worse memory, attention, and vocabulary, ADHD and autism spectrum disorders. Pollution has been shown to damage the development of neurons in the brain. Proximity to a coal plant can deform your DNA. It even accelerates the degeneration of eyesight.

A higher pollution level in the year a baby is born has been shown to reduce earnings and labor force participation at age thirty, and the relationship of pollution to premature births and low birth weight of babies is so strong that the simple introduction of the automatic toll collector E-ZPass

in American cities reduced both problems, in the vicinity of toll plazas, by 10.8 percent and 11.8 percent, respectively, just by cutting down on the exhaust expelled when cars slowed to pay by hand.

Stock market returns are lower on days with higher air pollution. Crime goes up, especially violent crimes; a 10% reduction in pollution, one paper found, could reduce the costs of crime in the United States by \$1.4 billion per year. When there's more smog in the air, chess players make more mistakes, and bigger ones. Politicians speak more simplistically, and referees make more bad calls. Even short-term exposure to particulate pollution can dramatically increase rates of respiratory infections, with every additional ten micrograms per cubic meter associated with a rise in diagnoses between 15 and 32 percent. Blood pressure goes up, too. The list goes on, with new research to add seemingly by the week.

A recent comprehensive global review found that air pollution damages every organ, indeed virtually every cell, in the body. Nanoparticles of pollution have been found inside the brainstems of even the very young. But you don't have to wait until birth to see the effects of breathing particulate matter. The impacts begin in the womb, damaging the development of lungs and thereby shortening the future lives of the fetuses who encounter them there. That may be all of them: in 2019, a small-scale study found particles of black carbon on the inside of every single placenta that was examined, meaning those particles had traveled through the respiratory tract of every single mother in the study and passed through the placental barrier to each unborn child. The study was designed to examine the different exposure of fetuses in areas with different levels of pollution; but while those in high-pollution areas exhibited more black carbon than those in low-pollution areas, the carbon showed up in what were thought to be enviably clean-air pregnancies, too. There were thousands of particles found in every cubic millimeter of placenta.

But pollution is not the sum total of the health risks of climate change, of course. Tropical diseases—malaria, dengue, yellow fever—will become much more common, as the natural range of the mosquitoes that carry them will grow northward. We can already observe a similar phenomenon with Lyme disease, carried by ticks. As Mary Beth Pfeiffer has documented, Lyme case counts have spiked in Japan, Turkey, and South Korea, where the disease was literally nonexistent as recently as 2010—zero cases—and now lives inside hundreds more Koreans each year. In the Netherlands, 54 percent of the country's land is now infested; in Europe as a whole, Lyme caseloads are now three times the standard level. In the United States, there are likely around 300,000 new infections each year— and since many of even those treated for Lyme continue to show symptoms years after treatment, the numbers can stockpile. Overall, the number of disease cases from mosquitoes, ticks, and fleas have tripled in the U.S. over just the last thirteen years, with dozens of counties across the country encountering ticks for the first time. But the effects of the epidemic can be seen perhaps most clearly in animals other than humans: in Minnesota, during the 2000s, winter ticks helped drop the moose population by 58 percent in a single decade, and some environmentalists believe the species could be eradicated entirely from the state as soon as 2020.

Those are insect-borne diseases; diseases are also water-borne, and those are likely to grow in significance, as well, as flooding becomes more common and water infrastructure is more often overwhelmed. Historically, in the United States, more than two-thirds of outbreaks of waterborne disease were preceded by unusually intense rainfall, disrupting local water supplies. The concentration of salmonella in streams, for instance, increases significantly after heavy rainfall, and the country's most dramatic outbreak of waterborne disease came in 1993, when more than 400,000 in Milwaukee fell ill from cryptosporidium immediately after a storm.

Sudden rainfall shocks—both deluges and their opposite, droughts—can devastate agricultural communities economically, but also produce what scientists call, with understatement, “nutritional deficiencies” in fetuses and infants; in Vietnam, those who passed through that crucible early on, and survived, were shown to start school later in life, do worse when they got there, and grow less tall than their peers. In India, the same cycle-of-poverty pattern holds. The lifelong impacts of chronic malnutrition are more troubling still for being permanent: diminishing cognitive ability, flattened adult wages, increased morbidity. In Ecuador, climate damage has been seen even in middle-class children, who bear the mark of rainfall shocks and extreme temperatures on their wages twenty to sixty years after the fact.

Though it is not often thought of as such, heat represents a quite significant threat to the health of Americans—in fact in most years heat waves kill more Americans than hurricanes, tornadoes or floods. Annually, it's estimated that 12,000 Americans die each year from the effects of heat, a number that could grow by 2100, under a high-emissions pathway, to 97,000, according to recent research by Drew Shindell—research that includes the effects of adaptation to heat. Globally, it's been estimated by Tamma Carleton that just the temperature effect of unmitigated climate change could expand mortality from heat to five times the death toll of COVID-19—and more than all other infectious diseases combined. This research, too, includes the effects of adaptation. If we mitigate warming and suppress global temperature rise to 2 degrees Celsius, almost certainly we will still see heat becoming deadlier every year than COVID-19 was in 2020.

**Statement of Rosalina (Rose) M. Fini****President-Elect, Cleveland Metropolitan Bar Association/  
Chief Legal & Ethics Officer, Cleveland Metroparks  
Senate Budget Committee Hearing on the Cost of Inaction on Climate Change**

April 15, 2021

Chairman Sanders, Ranking Member Graham, and other members of the committee, thank you for the opportunity to offer testimony to the Committee on the imperative for climate change action. As Counsel for Cleveland Metroparks, I have a front row seat on the impact of climate change and the need for an urgent response. I am also the President-Elect of the Cleveland Metropolitan Bar Association, which represents over 5,000 thousand attorneys, offering education and programs. We recently held a statewide discussion on the impact of climate change, and I would like to share those lessons as well.

Established in 1917, Cleveland Metroparks spans more than 24,000 acres across Northeast Ohio including eighteen reservations, more than 300 miles of trails, eight golf courses, eight lakefront parks and the nationally acclaimed Cleveland Metroparks Zoo. The Park District offers thousands of education and recreation programs and events each year across the forty-nine communities it serves, helping to create connections to nature and promote conservation and sustainability. The oldest park district in Ohio, the Cleveland Metroparks was the brainchild of a young, self-taught engineer, William Stinchcomb, whose genius was to anticipate the future need of a growing city for protected greenspace. Over time, the Park District grew to embrace some of the most scenic areas of Greater Cleveland.

I also serve as President-Elect of the Cleveland Metropolitan Bar Association, where we recently hosted a statewide discussion on Climate Change, hearing the experiences around the state, and hosted EPA Deputy General Counsel Marianne Engelman-Lado.

- We heard from Randell McSheperd talking about Cleveland's central neighborhoods, where residents face loss of green space, heat islands and tree canopy decline. These climate change effects pose health risks to children and seniors alike, ranging from childhood asthma to heart disease. Randy and friends are transitioning abandoned land into farmland, offering better food, sales income, cooler temperatures and fresh air.
- We heard from Dave Schmitt of the Mill Creek Alliance, in the Cincinnati area, describing the risks to the community when storm surges overrun the riverbanks of Mill Creek, which runs through Cincinnati to the Ohio River. These extreme storm surges have become more substantial, more frequent and more unpredictable due to climate change, posing both economic loss and health risks with flooding for the residents, many who can least afford to carry those risks, burdens and costs.

The discussion raised significant issues of environmental equity, the result of decades of housing and lending discrimination, and impacts everything we do: where are the toxic waste sites? Where do we decide to spend contaminated site clean-up funds? Are clean air and water enforcement actions protecting the health of all Americans? The equity and fairness decisions impact all areas of environmental decision-making. To be blunt and clear -- are we fairly distributing the environmental benefits and burdens of this nation?

As Counsel to Metroparks and Metroparks Zoo, we are acutely aware of the risks of climate change. From more heat, rain or drought to the rate of crop production to changing patterns of animal and bird migration, climate change is affecting us and changing the world around us. Increased stormwater runoff is deleterious to Cleveland Metroparks. When a residential neighborhood experiences uncontrolled stormwater runoff, flooded streets and basements ensue. The natural environment of the Metroparks, however, experiences even greater stormwater runoff damage, because unnaturally fast-flowing runoff from developed areas outside the parks inevitably makes its way to parkland waterways. The effect is cumulative, as the Metroparks' small streams catch stormwater runoff from adjacent neighborhoods and terminate into rivers receiving runoff from many surrounding square miles. In fact, the majority of the Greater Cleveland area drains into the streams and rivers within the Metroparks' system. The drainage area of the Cuyahoga River by itself is 809 square miles. In effect, the Metroparks serve as a regional stormwater catch basin, receiving an enormous volume of water that flows at accelerated rates from developed areas, (*i.e.*, water-impervious surfaces) lacking any natural stormwater controls.

Because of increased impervious surface resulting from continued development in the regions, the physical impact of stormwater runoff on the Metroparks is profound and far exceeds the volume the area ecosystem is naturally capable of handling. First, erosion occurs when the waterways are repeatedly subjected to unnaturally high flows, causing the loss of aquatic habitats. Stream beds that normally contain combinations of pools, runs and riffles with sand and gravel bottoms become scoured to bed rock. The aquatic creatures that live in the stream bed material are lost as well. As the stream beds deepen from continuous scouring, flood flows are not able to spread out over the flood plain as they would in a stable, natural system. These deeper eroded channels contain all of the energy of the flowing water in a confined space, which causes erosion of the stream banks, which in turn deposits large amounts of silt into the water and removes stream bank habitat, including stabilizing features such as tree roots and gravel bars. (As much as 45,000 tons of silt is flushed from waterways within the Metroparks' system into Lake Erie each year.) These concentrated flows also damage park culverts and bridges, resulting in washed out supports, pavement and roadways.

The volume and speed of stormwater runoff are not the only unnatural factors causing damage to the Metroparks' environment: urban pollutants in the runoff present an additional issue. Water-impervious surfaces in developed areas accumulate oil and grease from vehicles, natural debris and miscellaneous trash. During a storm event, absent an effective management program, oil and trash are flushed directly into streams, where the chemical and other pollutants become trapped in the stream sediments (and are further transported during storm events) and in the wetland ecosystems through which the streams pass. Wildlife feeding in the wetlands ingests the trash or otherwise becomes entangled in it. For a time the wetlands can perform their natural function and filter the pollutants, but eventually their capacity is overwhelmed by the episodic flows and pollutants from storm events, and the quality of the wetland vegetation is degraded. As the wetlands' water quality decreases, the aquatic life decreases, along with the bird populations that feed on the aquatic life.

Not only are we concerned about the effects of increased stormwater, but the health of our forests is a top concern stemming from climate change. Cleveland Metroparks is beginning a three-year project to quantify carbon capture and forest resiliency. The goals of this project are to evaluate Cleveland Metroparks approximately 16,000 acres of forest to understand carbon capture, storage and sequestration and to manage forest to be resilient to climate change. Ohio may be the buckeye state, but it won't be home to buckeye trees much longer, as they are thriving northward and declining to the south.

The National Ocean and Atmospheric Administration reports that in 2020, the US experienced a record twenty-two weather events that cost at least \$1 billion each in damages, comprising severe storms and at least seven hurricanes. With inaction, the crisis has worsened and grown more costly.

Climate change isn't just placing families at risk, but certainly businesses will suffer as well. The energy industry has been identified as particularly vulnerable, as severe storms in Texas recently demonstrated. The frequency, intensity and unpredictability of storms is increasing, a fact which even energy companies acknowledge. In 2019 testimony before the North Carolina Department of Environmental Air Quality, Duke Energy recognized that if the Company did not update storm preparation to account for the climate change reality there will be implications for the Company's assets and the ability of its customers to cope with the impacts of those storms.

Our Ohio state-wide discussion identified that we need to address the challenges and costs of climate change. We will find that it is less expensive to prepare, plan and mitigate, than wait for the cost of widespread economic disruption and the ruinous health consequences. This nation has vast environmental benefits and burdens and both need to be shared equitably. The environmental burdens, the storms, flooding and heatwaves, are accelerating in frequency and cost. Storms do not respect boundaries of cities, states or nations. We have a unified problem and need broad, cooperative effort to create solutions.

Mr. Chairman, at Metroparks we administer a \$135 million budget. While we offer an estimated \$873 million in economic value to the community, we still must be good stewards and neither of us can claim unlimited financial resources. I note the Biden/Harris proposed 2022 budget would increase climate spending by \$14 billion and boost the EPA and National Science Foundation's budgets by 20%, including \$1.4 billion for EPA environmental justice initiatives. From a legal perspective, one recommendation I would make to is to increase resources for policy development and enhanced enforcement. In Cleveland, we are considering how to attract more attorneys into public service to take a lead role in creating and administering the policies that are necessary to combat climate change in local, state and federal offices through a loan forgiveness program for graduates working or teaching in low-income communities. These students are often performing in a low-pay, but highly meaningful, work environment as they begin their career. If this sort of reform is to be approved by Congress, coverage for students should also extend to law graduates, who forego larger pay for

work in governmental or non-profit service. This could provide important relief for students at urban law schools, many who have fewer personal and family financial resources to pursue their degree and are more likely to face burdensome loans and crushing debt. We are also considering the creation of an environmental law clinic to assist the EPA and communities to pursue enforcement actions.

Much like the Civilian Conservation Corps, which operate in the 1930s and '40s during the Great Depression, the federal government could assist those who assisted us all through important environmental and conservation work. These reforms would empower local organizations and young individuals to address one of the most important challenges of our time.

Our nation needs to act now to build our national climate change resilience. It will be less disruptive and ultimately less costly to prepare, plan and mitigate climate change risks and costs, than wait out the looming extreme weather events and then face the personal, business and community disruption costs, by picking up, cleaning up and rebuilding.

Mr. Chairman, I thank you for this hearing and this opportunity to share my views following our recent Ohio discussion hosted by the Cleveland Metropolitan Bar Association and my perspective as Counsel to the Cleveland Metroparks and on behalf of the Cleveland Metroparks Chief Executive Officer Brian Zimmerman. The United States, as well as the rest of the world need to move forward and prepare for our new climate reality. We cannot wait.

